Stormwater Report

for

Afonso Village II

Westboro Road
Grafton, MA

Date: December 28, 2021

Prepared By:
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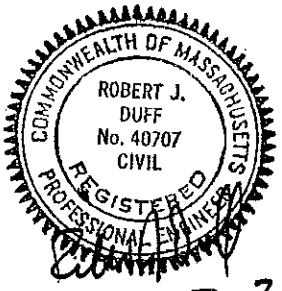

7.22.2022

Prepared for:
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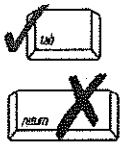
W-2658

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

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Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

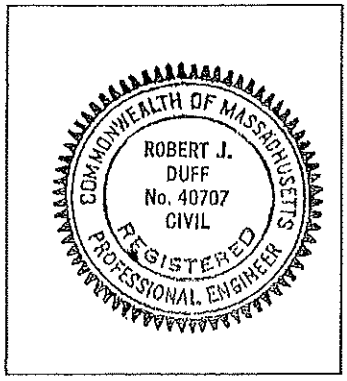
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature



Signature and Date 2/22/2022

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☒ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☒ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☒ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☒ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☒ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☒ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☒ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☒ Description and delineation of public safety features;
- ☒ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

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NARRATIVE

This report was prepared on behalf of the applicant D&F Afonso Builders, Inc. The project development area is 45,880+- sf. (1.05+/-Ac.) owned by the Applicant. The property is currently a vacant lot, with a sewer pump station recently constructed in the northwestern corner of 100 Westboro Road. The property is bordered by residential and institutional uses, woods, and wetlands. The site is located within the Village Mixed Use zoning district and has frontage along Westboro Road. Portions of the site lie within the jurisdictional buffers of bordering vegetated wetlands, and is located within a mapped water resource district.

PROJECT DESCRIPTION

The Applicant is proposing to construct two new four unit townhouses and associated driveways, utilities, and grading. Drainage infrastructure associated with the new development will also be constructed. The topography consists of slopes ranging from 0% to 10% grade. The property is bordered to the east by a state owned institutional use, to the north by residential homes, and to the west and south by wetland resource areas. The stormwater management system will also incorporate the runoff from the recently constructed sewer pump station in the northwest portion of the lot.

DESCRIPTION OF EXISTING DRAINAGE

The Pre-Developed site drains principally to the southwest, with approximately 124,015 square feet of residential properties, woodland, pavement, and lawn areas draining to the western wetlands overland, flowing across the project property. The pre-development drainage area is modeled as two hydrologic areas. These hydrologic areas are shown on the Pre-Development Watershed Plan attached to this report and are denoted as EX-1 and EX-2.

DESCRIPTION OF PROPOSED DRAINAGE FACILITIES

The proposed drainage system to manage stormwater from the proposed development consists of Deep Sump Hooded Catch Basins, a Sediment Forebay, and an Infiltration Basin. Stormwater from lawns, driveways, roofs, and the sewer pump station is collected and conveyed by a conventional catch basin and drain manhole system to the sediment forebay/infiltration basin for treatment, detention, and infiltration. Runoff is discharged from the infiltration basin to the western wetlands via a riprap spillway.

In the Post-Development condition, two hydrologic areas were considered. These watershed areas consider the town houses, driveways, lawns, and drainage facilities proposed to be constructed. These hydrologic areas are shown on the Post-Development Watershed Plan attached to this report and are denoted as PR-1 and PR-2.

PR-1 contains approximately 43,212 square feet of contributing area and includes the land which drains to the proposed Infiltration Basin. Runoff is captured by the catch basins and is conveyed to the west and then discharged to the sediment forebay and infiltration basin for treatment, detention, and infiltration.
PR-2 contains approximately 80,821 square feet of contributing area and includes all land not captured by the proposed drainage improvements which drains southwesterly to the abutting wetlands.

This report documents design compliance with the applicable sections of the Massachusetts Stormwater Management Standards 1-10.

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Stormwater Design Parameter:

The stormwater management system was designed to control the post-development rate of peak rainfall runoff from the site by keeping it below the post-development peak rate of rainfall runoff as stated as the objective in the Massachusetts Stormwater Handbook. The calculations were performed using the HydroCAD hydraulic program, developed by applied Microcomputer System. The HydroCAD software is based upon the Soil Conservation Service, "Technical Release 55 – Urban Hydrology for Small Watersheds" and is generally accepted industry methodology.

The analysis was performed for the 2-year, 10-year, and 100-year 24-hour storm events.

The following data was required for input:

- Watershed Area: Areas of each watershed were calculated and expressed in square feet for these calculations.
- SCS Curve Number (Cn): Based on the cover type and hydrologic soil group, a weighted curve number (CN) was determined for each of the existing watersheds utilizing Table 2-2a- *Runoff Curve Numbers For Urban Areas* and *Worksheet 2, Runoff Curve Number and Runoff* from the Soil Conservation Service Technical Release 55 – Urban Hydrology for Small Watersheds.
- Time of Concentration, Tc (Minutes): The time of concentration for each watershed was determined by finding the time necessary for runoff to travel from the hydraulically most distant point in the watershed to the point of analysis. This was calculated by using a minimum time of 6 minutes for runoff to reach the most distant catch basin.
- SCS 24-Hour Storm Type: For the greater New England region, a Type III storm rainfall distribution is recommended for drainage calculations and was used for this project.
- Rainfall Precipitation: Rainfall precipitations used the Cornell Extreme Precipitation Rainfall Estimates for Grafton for the 2, 10, and 100 year storm events and are as follows:

2-year storm event:	3.24 inches
10-year storm event:	4.88 inches
100-year storm event:	8.82 inches

An on-site conventional storm drainage collection system is designed based on the "Rational Method" using Manning's equation to carry a minimum 25-year storm event and underground culverts to carry a minimum 50-year storm event through the site (See Pipe Sizing Attachments). The proposed drainage pipes will be High Density Polyethylene (HDPE), unless otherwise noted on the plans.

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Standard 1: No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

All Paved area runoff from the proposed parking area will sheet flow across the pavement areas, accumulate into hooded catch basins, connect with drain pipe to a sediment forebay, which discharge to the infiltration basin. No new untreated stormwater discharges are proposed.

Standard 2: Stormwater management systems shall be designed so that the post-development peak discharge rates do not exceed pre-development peak discharge rates.

To meet Standard 2, the post-development peak discharge rate must be equal to or less than pre-development rates to prevent storm damage and downstream and offsite flooding from the 2-year and the 10-year 24-hour storm events.

Peak discharge rates were calculated and evaluated at the southern and western property lines. The point of evaluation is shown on the accompanying watershed plans.

In summary of the attached drainage analysis (HydroCAD), the peak discharge rates at the point of evaluation in cubic feet per second (cfs) are as follows;

		Run off		
	Storm Events	Pre (cfs)	Post (cfs)	Change (cfs)
Analysis Point 1 (AP-1)	2-year	1.5	1.5	0.0
	10-year	3.7	3.6	-0.1
	100-year	10.6	10.5	-0.1

Standard 3: Loss of annual recharge to ground water shall be eliminated or minimized through the use of environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post- development site shall approximate the annual recharge from pre-development conditions based on soil type. This standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

Soil Evaluation

Soil evaluation is broken down into two stages. Stage 1 identifies the underlying soils just beneath the surface that contribute to how much runoff is generated as stormwater falls and moves across the surface. Stage 2 evaluates the soils in direct contact with the proposed infiltration BMPs. The attachments section includes the NRCS Soil Survey used for Stage 1 while the site plan set includes the on-site soil textural analysis in the specific locations that infiltration is proposed. The information from the NRCS Soil Survey is included on the Pre and Post Development Watershed Plans.

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Recharge Volume

The required recharge volume is determined by calculating the impervious area proposed over the corresponding soil identified in the NRCS Soil Survey. Soils underlying the site are defined as map units 245B Hinckley Loamy Sand (HSG A), 600 Gravel Pits (HSG A), 422B Canton Fine Sandy Loam (HSG B), and 317B Scituate Fine Sandy Loam (HSG C).

Table 2: Required Recharge Volume Calculation

	Recharge	Impervious	Volume
Hydrologic Group	(in/sqft)	(sqft)	(cf)
A - *sand*	0.60	14,113	705.7 cf
B - *loam*	0.35	4,617	134.7 cf
C - *silty loam*	0.25	None	0
D - *clay*	0.10	None	0
		Required Recharge Volume Total	**840.4 cf**

Stormwater Basin Sizing

There are three ways of determining the recharge volume provided by a storm water basin (Static, Simple Dynamic and Dynamic Field). The Static Method, used here, includes the volume of water that can be stored beneath the lowest outlet of the basin. This, the most conservative method of determining the recharge volume, doesn't account for any infiltration that takes place while the basin is filling with water and is less dependent on maintenance of the basin since the only way for the water below the lowest invert can leave the basin is though infiltration. The following table summarizes the recharge volume provided by the infiltration basin. Detailed volume calculations for the basin are included in the attachments.

Table 3: Basin Recharge Volumes

	Recharge Volume
Basin 1 @ 363.50	5,955 cf
Total	5,955 cf

72-hour Drawdown

When using the conservative Static Method to determine infiltration volume provided, the Rawls Rate is used to represent the infiltration rate in place of a hydraulic conductivity rate. The specific rate chosen is based on the textural analysis of the in-site soil performed by a competent soil professional.

A Massachusetts Certified Soil Evaluator performed an evaluation of the soil at the proposed infiltration BMP. The soil textural analysis for the infiltration BMP is listed below with the associated Rawls Rate used in the HydroCAD calculations. Where textural analysis varied within any single BMP, the most restrictive textural evaluation and Rawls Rate were used. Soil logs of the in situ soil evaluation are included within the Site Plan set.

Table 4: Rawls Rate

	Most Restrictive Soil Texture	Rawls Rate (in/hour)
Basin 1	Sand	2.41 in/hr

Drawdown time for the infiltration basin is modeled by HydroCAD and included in the attachments. The following table summarizes the drawdown time for the basin to show it will drawdown within the 72-hour maximum.

Table 5: Basin Drawdown

	Time for Drawdown
Basin 1	46 hours

Standard 4: Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This standard is met when:

- ***a) Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;***
- ***b) Structural stormwater best management practices are sized to capture the required water quality volume as determined in accordance with the Massachusetts Stormwater Handbook; and***
- ***c) Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.***

The Water Quality Volume requiring 80% TSS removal, is calculated as follows:

The required water quality volume is based on 1.0" as the soil recharge rate is 2.41 in/hr, meeting the threshold rate of 2.4 in/hr or greater. The water quality volume equals 1.0 inches of runoff times the increased impervious area of the post-development site.

Existing Site Impervious Area = 14,897 sf
Proposed Site Impervious Area = 24,630 sf
Total Site Impervious Area Increase = 9,733 sf
Impervious area to be treated = **9,733 sf**

Total volume to be treated:
1.0" x 1'/12" x 9,733 sf = 811 **cf Water Quality Volume Required**

Provided Water Quality Volume:

Treatment volume (infiltration basin) = 5,955 cf @ el. 363.50

See TSS Removal Calculations in Attachment Section.

Standard 4: requires the development and implementation of suitable practices for source control and pollution prevention. These measures must be identified in a long-term pollution prevention plan.

The long-term pollution prevention plan is incorporated into the Operation and Maintenance Plan required by Standard 9.

Standard 5: For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.

The proposed project is not a use with higher potential pollutant loads.

Standard 6: Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or to any other critical area require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook.

The subject property discharges stormwater within the Grafton WRDO. Due to rapid recharge rates present in the infiltration basin, the Water Quality Volume is calculated using the required 1.0" rule, and 44% TSS removal is achieved prior to discharge to the infiltration basin. See Standard 4 for computations. The design utilizes stormwater BMPs designated as suitable for critical areas within the Massachusetts Stormwater Handbook.

Standard 7: A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable:

This project is not a redevelopment project and meets all applicable stormwater standards.

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Grafton, MA

Standard 8: A plan to control construction-related impacts, including erosion, sedimentation, and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

During land disturbance and construction activities, project proponents must implement controls that prevent erosion, control sediment movement, and stabilize exposed soils to prevent pollutants from moving offsite or entering wetlands or waters. Land disturbance activities include demolition, construction, clearing, excavation, grading, filling, and reconstruction.

Construction Period Pollution Prevention Plan and Erosion and Sedimentation Control.
EPA NPDES – Storm Water Pollution Prevention Plan (SWPPP)

A. Names of Persons or Entities Responsible for Plan Compliance

Dominic Afonso
D&F Afonso Builders, Inc.
189 Main Street
Milford, MA 01757
Tel: 508-400-2436

B. Construction Period Pollution Prevention Measures

1. Inventory materials to be present on site during construction.
2. Train employees and subcontractors in prevention and clean up procedures.
3. All materials stored on site will be stored in their appropriate containers and if possible under a roof or covered.
4. Follow manufacturer's recommendation for disposal of used containers.
5. Store only enough products on site to do the job.
6. On site equipment, fueling and maintenance measures:
    a. Inspect on-site vehicles and equipment daily for leaks.
    b. Conduct all vehicle and equipment maintenance and refueling outside of 100' wetland buffer, away from storm drains.
    c. Perform major repairs and maintenance off site.
    d. Use drip pans, drip cloths or absorbent pads when replacing spent fuels.
    e. Collect spent fuels and remove from site, per Local and State regulations.
    f. Maintain a clean construction entrance; install a crushed stone apron where truck traffic is frequent to reduce soil compaction constant sweeping is required and limit tracking of sediment into streets, sweeping street when silt is observed on street.
7. A temporary concrete washout station and equipment wash station shall be located on the site. Areas shall be surrounded with a silt fence and or Filter Mitt to contain materials and provide ease of cleanup.
8. Stock pile materials, and maintain Erosion Control around the materials where it can easily be accessed. Maintain easy access to clean up materials to include brooms, mops, rags gloves, goggles, sand, sawdust, plastic and metal trash containers.
9. Clean up spills.
    a. Never hose down "dirty" pavement or impermeable surfaces where fluids have spilled. Use dry cleanup methods (sawdust, cat litter and/or rags and absorbent pads).
    b. Sweep up dry materials immediately. Never wash them away or bury them.

c. Clean up spills on dirt areas by digging up and properly disposing of contaminated soil in a certified container and notify a certified hauler for removal.
d. Report significant spills to the Fire Department.

10. It is the responsibility of the site superintendent or employees designated by the Applicant to inspect erosion control and repair as needed, also to inspect all on site vehicles for leaks and check all containers on site that may contain hazardous materials daily.

C. Site Development Plans
1. See Site Plan set "Site Plan Plan of Land Afonso Village II Single Family Attached Dwellings Town Houses in Grafton, MA" dated December 28, 2021, prepared by Guerriere & Halnon, Inc.

D. Construction Erosion and Sedimentation Control Plan;
1. See Site Plan set "Site Plan Plan of Land Afonso Village II Single Family Attached Dwellings Town Houses in Grafton, MA" dated December 28, 2021, prepared by Guerriere & Halnon, Inc.

E. Plans
1. Construction Sequencing Plan
a. A NPDES NOI shall be filed with the EPA.
b. Record Order of Conditions - The site superintendent shall be aware of all the Conditions contained within the Order including inspection schedules.
c. Install DEP File # Sign prior to commencement of work.
d. Prior to any work on the site including tree/brush clearing, the approved limit of clearing as well as the location of the proposed erosion control devices (such as silt fence/straw bales, etc.) must be staked on the ground under the direction of a Massachusetts registered Professional Land Surveyor.
e. Install erosion control barrier at locations depicted on the plans.
f. Erosion control to be inspected by either the design engineer (or agent) or an erosion control monitor appointed by the Town of Grafton.
g. Extra erosion control devices (at least 10% of the linear footage required for the site) shall be stored on the site to be used in case of an emergency (large storm).
h. Perform tree/brush removal.
i. Strip off top and subsoil. Stockpile material to be reused away from any drainage inlet or protected wetland areas, remove excess material from the site. Install and maintain erosion control barrier around stockpile.
j. Rough grade site, maintaining temporary low areas/sediment traps for sediment accumulation and away from the wetlands and prevent sedimentation from migrating from the site.
k. Construct forebay/basin, and outlets/outfalls. Install pipes, manholes and catch basins. Stabilize side slopes with loam, seed and mulch.
l. Install underground utilities; protect all open drainage structures with erosion/siltation control devices, and rope off any areas susceptible to heavy vehicle damage.
m. Prepare compacted pavement base.
n. Loam and seed (mulch as required) disturbed areas of site other than immediately adjacent to work area.

o. Upon all catchment structures and mitigation features becoming operational, install pavement up to binder finish grade. Straw bales backed by crushed stone to be provided on down gradient side of catch basins to direct water to temporary basin.
p. Install curbing and catch basin curb inlets.
q. Install final pavement wearing course.
r. Finish grade - loam and seed (mulch as required adjacent to parking lot.
s. Maintain all erosion control devices until site is stabilized and final inspections are performed.

The Contractor shall be responsible to schedule any required inspections of his/her work.

2. Construction Waste Management Plan
   a. Dumpster for trash and bulk waste collection shall be provided separately for construction.
   b. Recycle materials whenever possible (paper, plaster cardboard, metal cans). Separate containers for material are recommended.
   c. Segregate and provide containers for disposal options for waste.
   d. Do not bury waste and debris on site.
   e. Certified haulers will be hired to remove the dumpster container waste as needed. Recycling products will also be removed off site weekly.
   f. The sewer system is only for disposal of human waste.

F. Operation and Maintenance of Erosion and Sedimentation Controls

The operation and maintenance of sedimentation control shall be the responsibility of the contractor. The inspection and maintenance of the storm water component shall be performed as noted below. The contractor shall, at all times have erosion control in place. The contractor, based on future weather reports shall prepare and inspect all erosion control devices; cleaning, repairing and upgrading is a priority so that the devices perform as per design. Inspect the site during rain events. **Don't stay away from the site.** At a minimum, there should be inspection to assure the devices are not clogged or plugged, or that devices have not been destroyed or damaged during the rain event. After a storm event inspection is required to clean and repair any damage components. Immediate repair is required.

G. Inspection and Maintenance Schedules

1. Inspection must be conducted at least once every 7 days and within 24 hours prior to and after the end of a storm event 0.5 inches or greater.
2. Inspection frequency can be reduced to once a month if:
   a. The site is temporarily stabilized.
   b. Runoff is unlikely due to winter conditions, when site is covered with snow or ice.
3. Inspections must be conducted by qualified personnel, "qualified personnel" means a person knowledgeable in the principles and practice of erosion and sediment controls and who possess the skills to assess the conditions and take measures to maintain and ensure proper operation, also to conclude if the erosion control methods selected are effective.
4. For each inspection, the inspection report must include:
   a. The inspection date.
   b. Names, titles of personnel making the inspection.
   c. Weather information for the period since the last inspection.
   d. Weather information at the time of the inspection.
   e. Locations of discharges of sediment from the site, if any.

f. Locations of BMP's that need to be maintained.
g. Locations where additional BMP's may be required.
h. Corrective action required or any changes to the SWPPP that may be necessary.

5. Qualified personnel shall inspect the following in-place work;

Inspection Schedule:

Erosion Control	Weekly
Catch Basins	Weekly
Temporary Sedimentation Traps/Basins	Weekly
Pavement Sweeping	Weekly

Please Note: Special inspections shall also be made after a significant rainfall event.

Maintenance Schedule

Erosion Control Devices Failure	Immediately
Temporary Sedimentation Traps/Basins	As needed
Pavement Sweeping	14 days minimum and prior to any significant rain event.

Please Note: Special maintenance shall also be made after a significant rainfall event.

H. Inspection and Maintenance Log Form.
1. See Construction Phase Inspection and Maintenance Form attached

Standard 9: A Long –Term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that storm water management systems function as designed.

The following shall serve as the (O&M) Plan required by Standard 9, as well as the Long-Term Pollution Prevention Plan required by Standard 4.

A. Names of Persons or Entities Responsible for Plan Compliance;

Dominic Afonso
D&F Afonso Builders, Inc.
189 Main Street
Milford, MA 01757
Tel: 508-400-2436

It is the intent of the Applicant to have the site completed and released by the various town Departments and Boards.

B. Good housekeeping practices
1. Maintain site, landscaping and vegetation.
2. Sweep and pick up litter on pavements and grounds.
3. Deliveries shall be monitored by owners or representative to ensure that if any spillage occurs, it shall be contained and cleaned up immediately.
4. Maintain pavement and curbing in good repair.

C. Requirements for routine inspections and maintenance of stormwater BMPs

1. Plans: The storm water Operation and Maintenance Plan shall consist of all Plans, documents and all local state and federal approvals as required for the subject property.
2. Record Keeping:
   a. Maintain a log of all operation and maintenance activities for at least three years following construction, including inspections, repairs, replacement and disposal (for disposal, the log shall indicate the type of material and the disposal location);

3. Descriptions and Designs: The Best Management Practices (BMP) incorporated into the design include the following;
   a. Pavement Sweeping – Stipulated within the Construction Period Pollution Prevention Plan, the Long Term Pollution Prevention Plan, and the Operation and Maintenance Plan. As the amount of TSS removal is discretionary, no credit was taken within the calculations for this BMP.
   b. Deep sump catch basins with hoods installed to promote TSS Removal of solids and control floatable pollutants. This BMP has a design rate of 25% TSS Removal.
   c. Sediment Forebay - installed to promote TSS Removal of solids. This BMP has a design rate of 25% TSS Removal.
   d. Infiltration Basin – infiltration BMP provides the required groundwater recharge and has a design rate of 80% TSS Removal. Refer to TSS Removal Worksheet included in the Attachments.
   e. Spill Containment Kit to contain and clean-up spills that could occur on site.

4. BMP Maintenance: After construction it is the responsibility of the owner to perform maintenance. The cleaning of the components of the stormwater management system shall generally be as follows:
   a. Pavement: The owner shall keep the pavement swept with a mechanical sweeper or hand swept semi-annually at a minimum.
   b. Catch Basins: Shall be cleaned by excavating, pumping or vacuuming. The sediment shall be disposed of off-site by the Owner. Inspect quarterly, remove silt when ¼ full.
   c. Sediment Forebay: Inspect monthly. Clean forebay 4 times per year.
   d. Infiltration Basin: Inspect for proper function after every major storm event during the first 3 months of operation, inspect/remove debris twice per year afterward. Mow basin at least twice per year, remove clippings.

5. Access Provisions: All of the components of the storm water system will be accessible by the Owner

D. Spill prevention and response plans

1. Train employees and subcontractors in prevention and clean up procedures.
2. All materials stored on site will be stored in their appropriate containers under a roof or in the approved underground storage tanks.
3. Follow manufacturer's recommendation for disposal of used containers.
4. On site equipment, fueling and maintenance measures:
   a. Inspect on-site vehicles and equipment daily for leaks.
   b. Conduct all vehicle and equipment maintenance off Site and refueling in one location, away from storm drains and wetlands.
5. Clean up spills.

a. Never hose down "dirty" pavement or impermeable surfaces where fluids have spilled. Use dry clean-up methods (sawdust, cat litter and/or rags and absorbent pads).
b. Sweep up dry materials immediately. Never wash them away or bury them.
c. Clean up spills on dirt areas by digging up and properly disposing of contaminated soil.
d. Report significant spills to the Fire Department, Conservation Commission and Board of Health.

E. Provisions for maintenance of lawns, gardens, and other landscaped areas
Dispose of clippings away from storm drainage.

F. Requirements for storage and use of herbicides, and pesticides
The application of herbicides or pesticides will be done by professional certified contractor.

G. Provisions for solid waste management
1. Waste Management Plan
a. Recycle materials whenever possible (paper, plaster cardboard, metal cans). Separate containers for material is recommended.
b. Do not bury waste and debris on site.
c. Certified haulers will be hired to remove the dumpster container waste as needed. Recycling products will also be removed off site weekly.

H. Snow disposal and plowing plans
Snow storage is adequate around the site for large storm events, see site plan

I. Winter Road Salt and/or Sand Use and Storage restrictions
No sand, salt, or chemicals for de-icing will be stored outside.

J. Pavement sweeping schedules
Sweeping, the act of cleaning pavement can be done by mechanical sweepers, vacuum sweeper or hand sweeper. The quantity of sand is a direct correlation with the treatment of ice and snow and the types of chemicals and spreaders that are being used on site to manage snow. If a liquid de-icer such as calcium chloride is used as a pretreatment to new events the amount of sand is minimized. Sweeping for this site should be done semi-annually at a minimum. Collecting the particulate before it enters the catch basins is cheaper and more environmentally friendly than in a catch basin mixing with oils and greases in the surface water runoff in catch basins.

K. Provisions for prevention of illicit discharges to the stormwater management system
The discharge into the stormwater system is not being violated, see attachment for illicit discharges compliance.

L. Training the staff or personnel involved with implementing Long-Term Pollution Prevention Plan The owner shall develop policies and procedures for containing the illicit spilling of oils, soda, beer, paper, and litter. These wastes provide a degrading of the water quality. The placement of signs and trash barrels with lids around the site would contribute to a clean water quality site conditions.

M. List of Emergency contacts for implementing Long-Term Pollution Prevention Plan:

Dominic Afonso
D&F Afonso Builders, Inc.
189 Main Street
Milford, MA 01757
Tel: 508-400-2436

BMP	Estimated Maintenance Cost
Pavement sweeping	$ 400 per year
Catch basin cleaning	$ 200 per catch basin per cleaning
Sediment Forebay	$ 400 per year
Infiltration Basin	$ 500 per cleaning
Spill Containment Kit	$ 750 purchase price

Stormwater Report
Afonso Village II
Grafton, MA

Standard 10: All illicit discharges to the stormwater management system are prohibited.

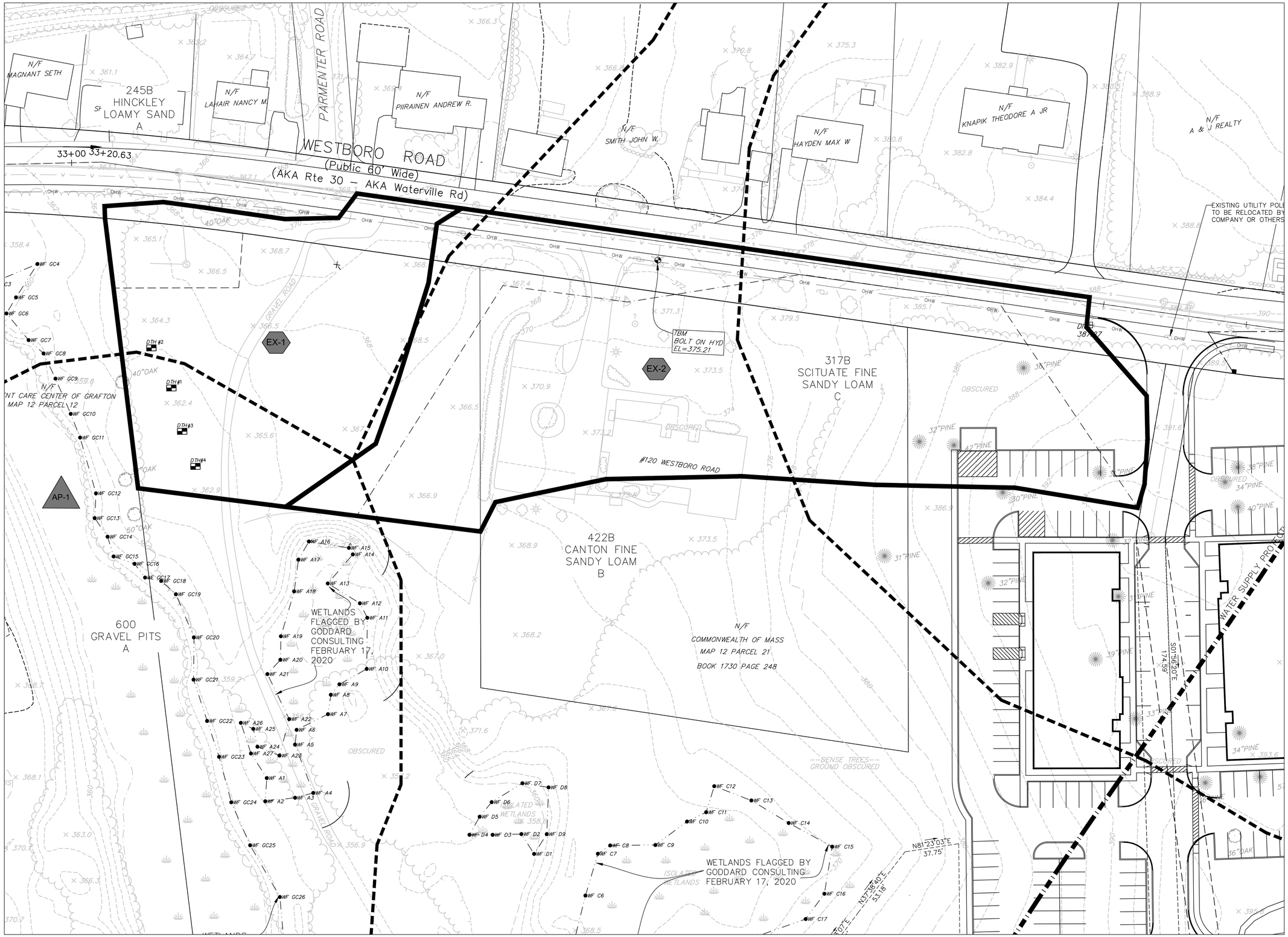
Standard 10 prohibits illicit discharges to stormwater management systems. The stormwater management system is the system for conveying, treating, and infiltrating stormwater on site, including stormwater best management practices and any pipes intended to transport stormwater to the ground water, a surface water, or municipal separate storm sewer system. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater. Notwithstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities: firefighting, water line flushing, landscape irrigation, uncontaminated ground water, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean residential buildings without detergents.

Illicit Discharge Compliance Statement

It is the intent of the Applicant, Dominic Afonso D&F Afonso Builders, Inc., 189 Main Street, Milford, MA 01757 to prevent illicit discharges to the stormwater management system, including wastewater discharges and discharges of stormwater contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease. There will be no connection to the storm water system to inadvertently direct other types of liquids, chemicals or solids into the storm drainage system. The Owner will also promote a clean Green Environment by mitigating spills onto pavements; oils, soda, chemicals, pet waste, debris and litter.

Respectfully Acknowledged,

Dominic Afonso



DATE: DATE:

TOWN PLANNING BOARD

SIGNATURE DATE:

BEING A MAJORITY

NOTES

1. CONSTRUCTION ON THIS LOT IS SUBJECT TO ANY EASEMENTS, RIGHTS–OF–WAY, RESTRICTIONS, RESERVATIONS OR OTHER LIMITATIONS WHICH MAY BE REVEALED BY AN EXAMINATION OF THE TITLE.
2. "WARNING" EXISTING UTILITY LINES INDICATED OR NOTED ON THESE DRAWINGS ARE SHOWN AS OBTAINED FROM EXISTING INFORMATION AND ARE ONLY APPROXIMATE IN LOCATION. THE CONTRACTOR SHALL TAKE CAUTION IN THESE AREAS TO AVOID DAMAGE TO EXISTING UTILITY LINES AND/OR HARM TO PERSONNEL ENGAGED IN WORKING IN THESE AREAS. CALL "DIG SAFE" 1–888–DIG–SAFE (1–888–344–7233). EXISTING LINES OTHER THAN THOSE INDICATED ON THESE DRAWINGS MAY BE ON THE SITE. THE CONTRACTOR IS WARNED TO PROCEED WITH CAUTION WITH ALL WORK, ESPECIALLY EXCAVATION WORK, AND TO MAKE ALL POSSIBLE INVESTIGATIONS AS TO POSSIBLE UNMARKED UTILITY LINES.

OWNER / APPLICANT

D&F AFONSO BUILDERS, INC.
189 MAIN STREET
MILFORD, MA 01757

EXISTING WATERSHED

AFONSO VILLAGE II

RESIDENTIAL TOWN HOUSES

SITE PLAN AND SPECIAL PERMIT

IN

GRAFTON, MA

01	12/28/21	INITIAL SUBMITTAL	MAH

GRAPHIC SCALE: 1"=30'

0 10 20 30 40 50 75 FEET
0 5 10 15 20 25 METERS

Guerriere & Halnon, Inc.
ENGINEERING & LAND SURVEYING
333 WEST STREET
MILFORD, MA 01757
PH. (508) 473–6630
FX. (508) 473–8243
www.gandhengineering.com

SHEET 1 OF 2

W–2658–2

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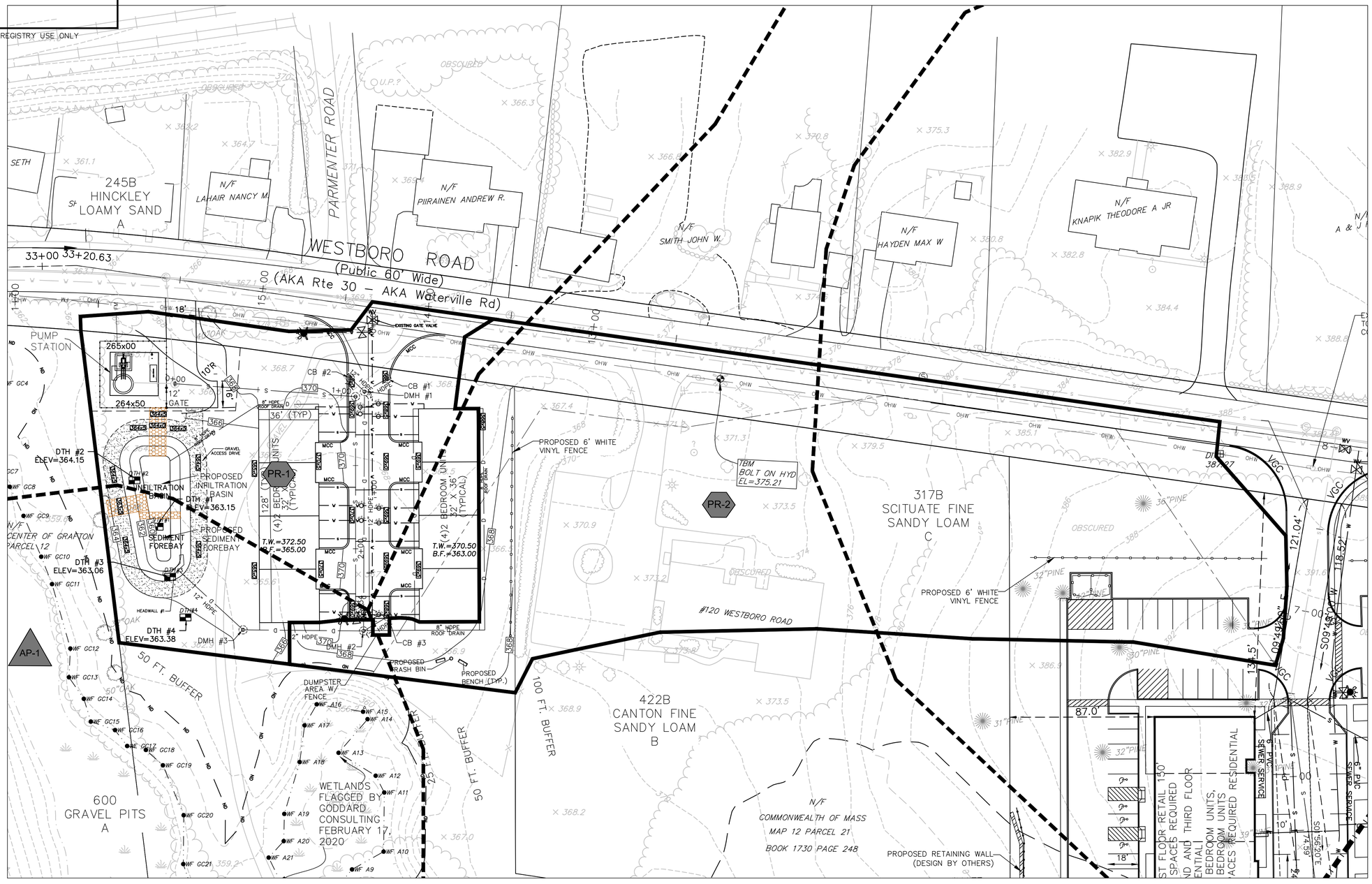
FOR REGISTRY USE ONLY



DATE: DATE:

TOWN PLANNING BOARD

SIGNATURE DATE:

BEING A MAJORITY

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OWNER / APPLICANT

D&F AFONSO BUILDERS, INC.
189 MAIN STREET
MILFORD, MA 01757

PROPOSED WATERSHED

AFONSO VILLAGE II

RESIDENTIAL
TOWN HOUSES
SITE PLAN AND
SPECIAL PERMIT
IN
GRAFTON, MA

01	12/28/21	INITIAL SUBMITTAL	MAH

GRAPHIC SCALE: 1"=30'

0 10 20 30 40 50 75 FEET
0 5 10 15 20 25 METERS

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SHEET 1 OF 2

W–2658–2

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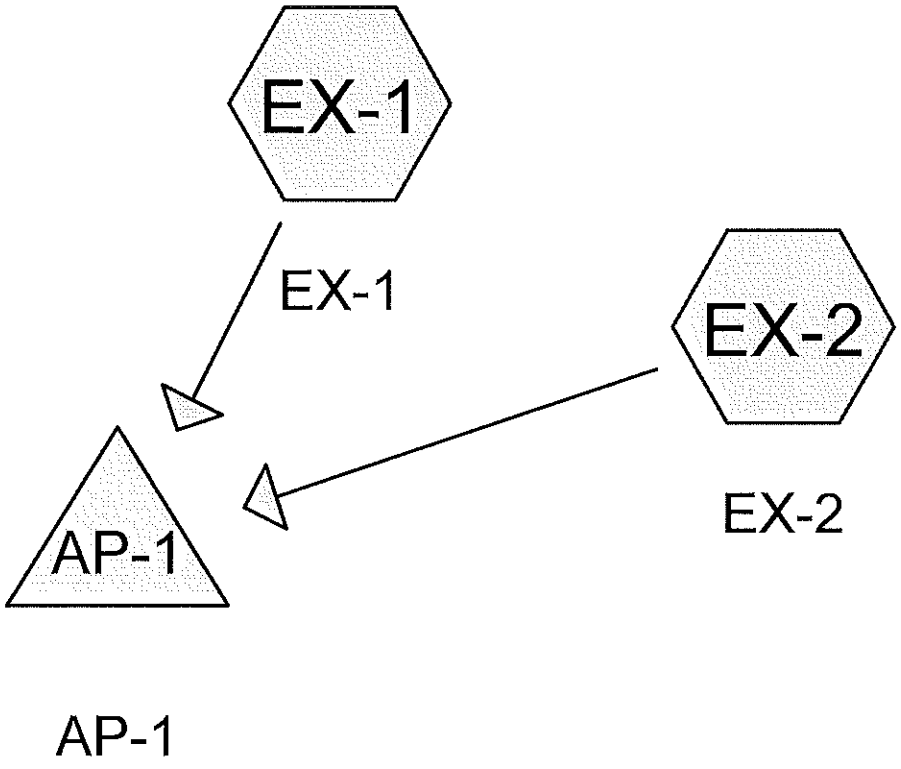


Subcat Reach Pond Link

Routing Diagram for W2658-1 Ex-Development
Prepared by {enter your company name here}, Printed 12/9/2021

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.864	39	>75% Grass cover, Good, HSG A (EX-1, EX-2)
0.725	61	>75% Grass cover, Good, HSG B (EX-1, EX-2)
0.294	74	>75% Grass cover, Good, HSG C (EX-2)
0.040	96	Gravel surface, HSG A (EX-1)
0.028	98	Paved parking, HSG A (EX-1, EX-2)
0.243	98	Paved parking, HSG B (EX-2)
0.071	98	Paved parking, HSG C (EX-2)
0.074	98	Roofs, HSG B (EX-2)
0.509	70	Woods, Good, HSG C (EX-2)
2.847	**63**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.932	HSG A	EX-1, EX-2
1.041	HSG B	EX-1, EX-2
0.874	HSG C	EX-2
0.000	HSG D	
0.000	Other	
2.847		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.864	0.725	0.294	0.000	0.000	1.884	>75% Grass cover, Good	EX-1, EX-2
0.040	0.000	0.000	0.000	0.000	0.040	Gravel surface	EX-1
0.028	0.243	0.071	0.000	0.000	0.341	Paved parking	EX-1, EX-2
0.000	0.074	0.000	0.000	0.000	0.074	Roofs	EX-2
0.000	0.000	0.509	0.000	0.000	0.509	Woods, Good	EX-2
0.932	**1.041**	**0.874**	**0.000**	**0.000**	**2.847**	**TOTAL AREA**	

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentEX-1: EX-1 Runoff Area=38,917 sf 2.32% Impervious Runoff Depth=0.03"
Tc=6.0 min CN=43 Runoff=0.00 cfs 0.002 af

SubcatchmentEX-2: EX-2 Runoff Area=85,117 sf 20.16% Impervious Runoff Depth=0.95"
Flow Length=708' Tc=14.9 min CN=72 Runoff=1.51 cfs 0.155 af

Pond AP-1: AP-1 Inflow=1.51 cfs 0.157 af
Primary=1.51 cfs 0.157 af

Total Runoff Area = 2.847 ac Runoff Volume = 0.157 af Average Runoff Depth = 0.66"
85.44% Pervious = 2.433 ac 14.56% Impervious = 0.415 ac

Summary for Subcatchment EX-1: EX-1

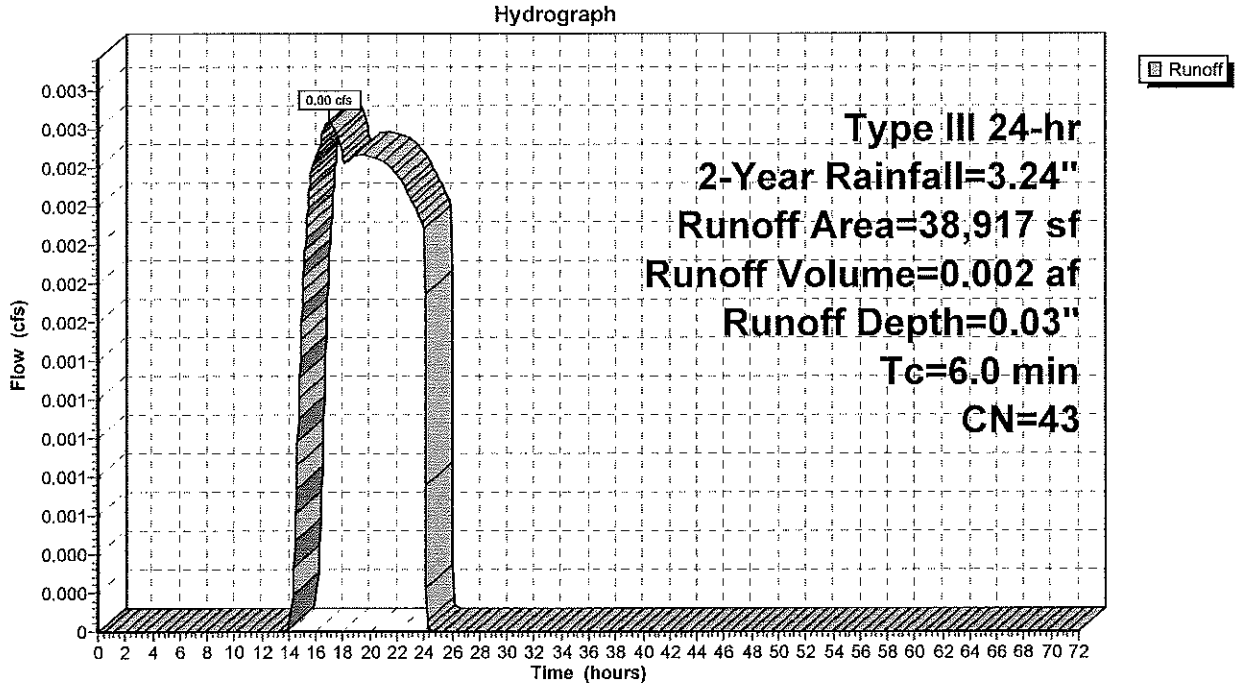
Runoff = 0.00 cfs @ 17.00 hrs, Volume= 0.002 af, Depth= 0.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.24"

Area (sf)	CN	Description
35,770	39	>75% Grass cover, Good, HSG A
492	61	>75% Grass cover, Good, HSG B
903	98	Paved parking, HSG A
1,752	96	Gravel surface, HSG A
38,917	43	Weighted Average
38,014		97.68% Pervious Area
903		2.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry,

Subcatchment EX-1: EX-1



Summary for Subcatchment EX-2: EX-2

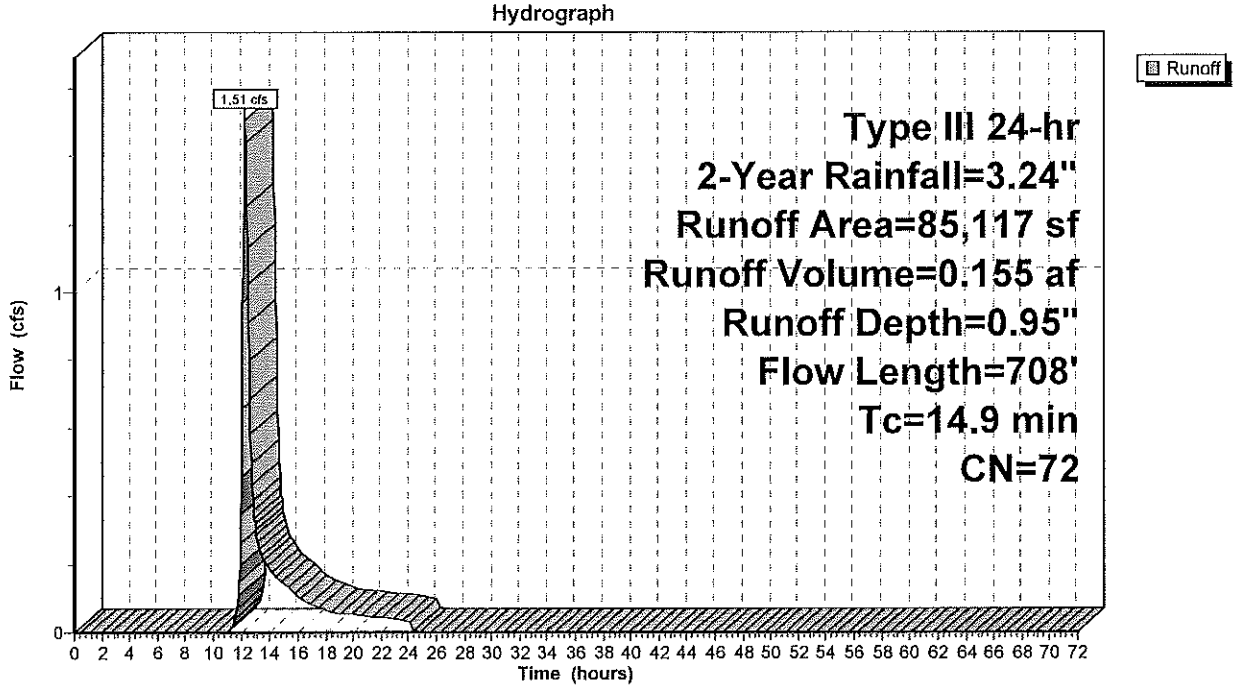
Runoff = 1.51 cfs @ 12.23 hrs, Volume= 0.155 af, Depth= 0.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.24"

Area (sf)	CN	Description
22,168	70	Woods, Good, HSG C
12,828	74	>75% Grass cover, Good, HSG C
3,081	98	Paved parking, HSG C
31,086	61	>75% Grass cover, Good, HSG B
10,575	98	Paved parking, HSG B
3,204	98	Roofs, HSG B
1,874	39	>75% Grass cover, Good, HSG A
301	98	Paved parking, HSG A
85,117	72	Weighted Average
67,956		79.84% Pervious Area
17,161		20.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.8	120	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.5	140	0.0600	4.97		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	120	0.0650	3.82		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.6	88	0.0300	2.60		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.0	190	0.0050	1.06		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
14.9	708	Total			

Subcatchment EX-2: EX-2



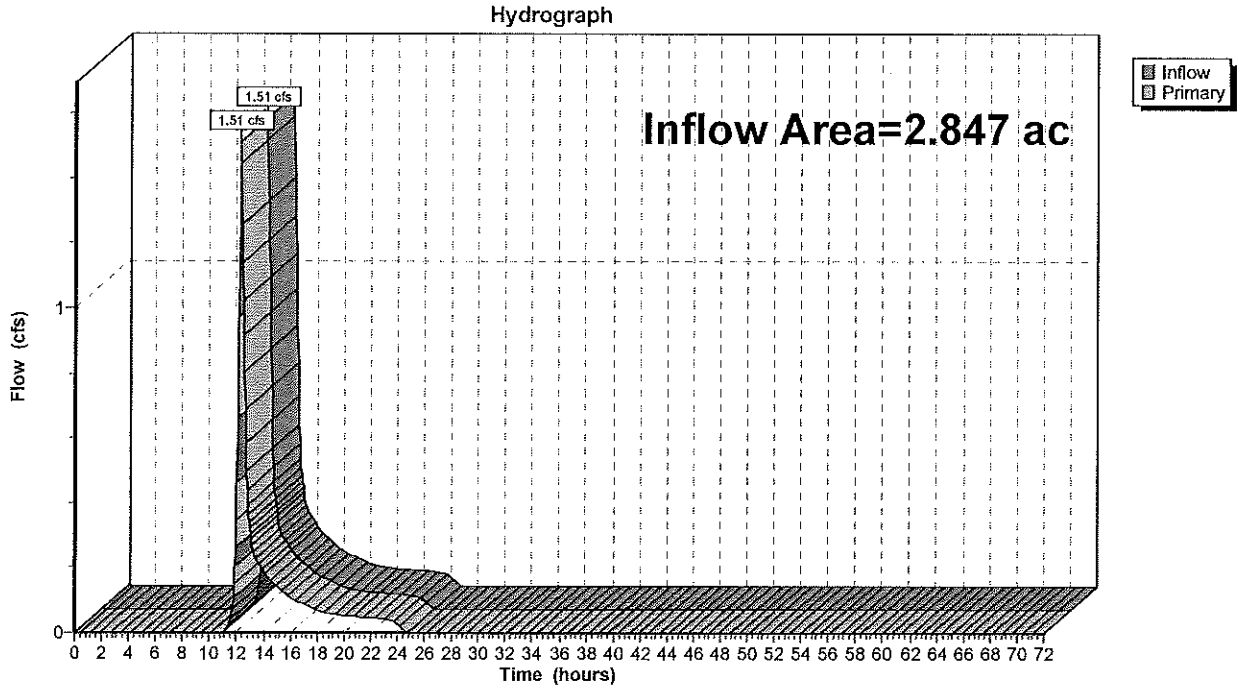
Summary for Pond AP-1: AP-1

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.847 ac, 14.56% Impervious, Inflow Depth = 0.66" for 2-Year event
Inflow = 1.51 cfs @ 12.23 hrs, Volume= 0.157 af
Primary = 1.51 cfs @ 12.23 hrs, Volume= 0.157 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Pond AP-1: AP-1



Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentEX-1: EX-1 Runoff Area=38,917 sf 2.32% Impervious Runoff Depth=0.32"
Tc=6.0 min CN=43 Runoff=0.10 cfs 0.024 af

SubcatchmentEX-2: EX-2 Runoff Area=85,117 sf 20.16% Impervious Runoff Depth=2.11"
Flow Length=708' Tc=14.9 min CN=72 Runoff=3.59 cfs 0.343 af

Pond AP-1: AP-1 Inflow=3.66 cfs 0.367 af
Primary=3.66 cfs 0.367 af

Total Runoff Area = 2.847 ac Runoff Volume = 0.367 af Average Runoff Depth = 1.55"
85.44% Pervious = 2.433 ac 14.56% Impervious = 0.415 ac

Summary for Subcatchment EX-1: EX-1

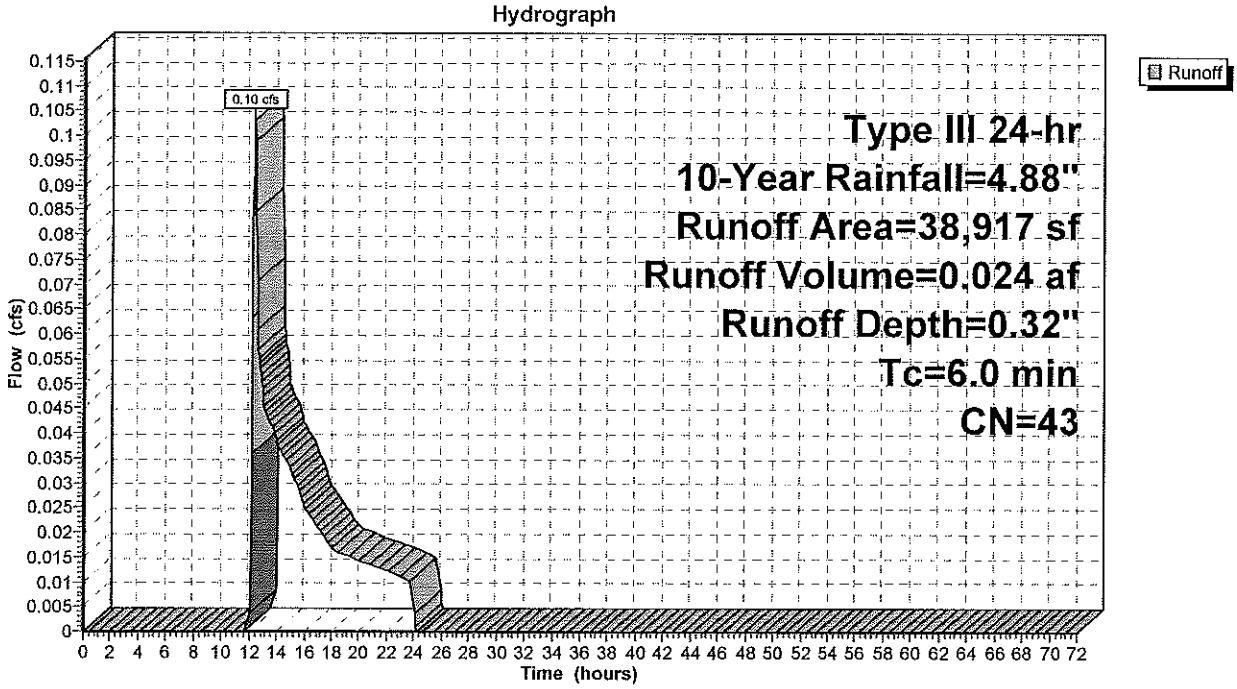
Runoff = 0.10 cfs @ 12.37 hrs, Volume= 0.024 af, Depth= 0.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.88"

Area (sf)	CN	Description
35,770	39	>75% Grass cover, Good, HSG A
492	61	>75% Grass cover, Good, HSG B
903	98	Paved parking, HSG A
1,752	96	Gravel surface, HSG A
38,917	43	Weighted Average
38,014		97.68% Pervious Area
903		2.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment EX-1: EX-1



Summary for Subcatchment EX-2: EX-2

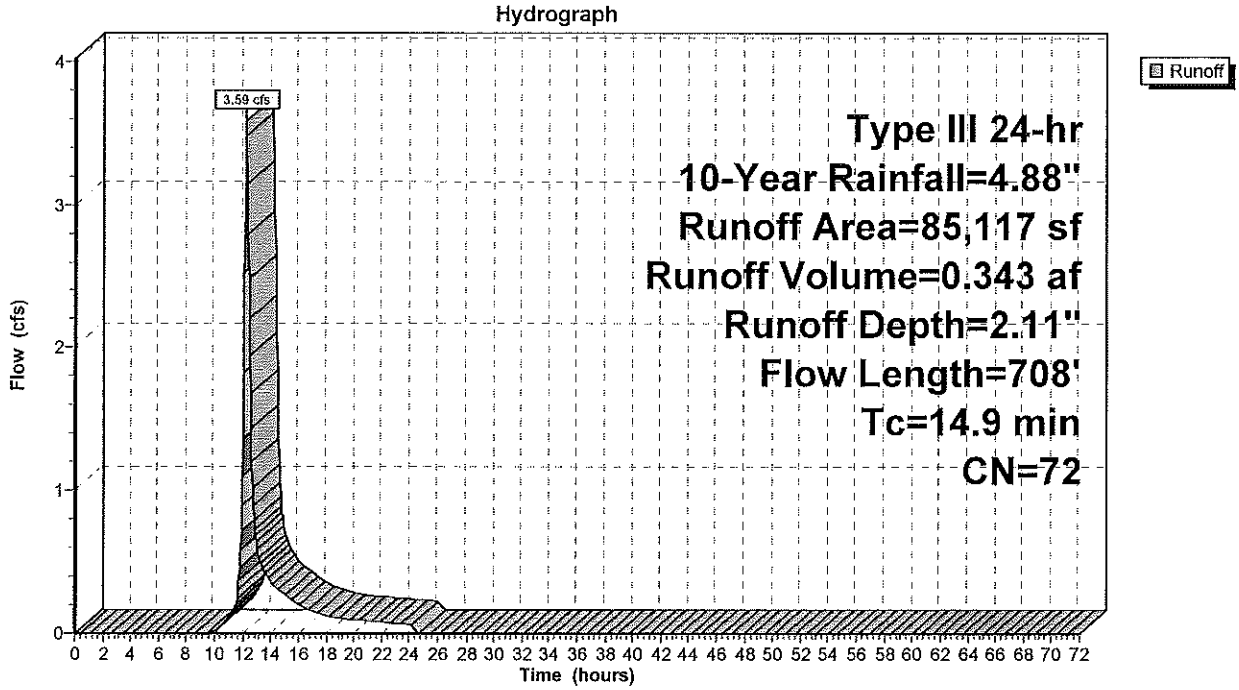
Runoff = 3.59 cfs @ 12.21 hrs, Volume= 0.343 af, Depth= 2.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.88"

Area (sf)	CN	Description
22,168	70	Woods, Good, HSG C
12,828	74	>75% Grass cover, Good, HSG C
3,081	98	Paved parking, HSG C
31,086	61	>75% Grass cover, Good, HSG B
10,575	98	Paved parking, HSG B
3,204	98	Roofs, HSG B
1,874	39	>75% Grass cover, Good, HSG A
301	98	Paved parking, HSG A
85,117	72	Weighted Average
67,956		79.84% Pervious Area
17,161		20.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.8	120	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.5	140	0.0600	4.97		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	120	0.0650	3.82		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.6	88	0.0300	2.60		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.0	190	0.0050	1.06		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
14.9	708	Total			

Subcatchment EX-2: EX-2



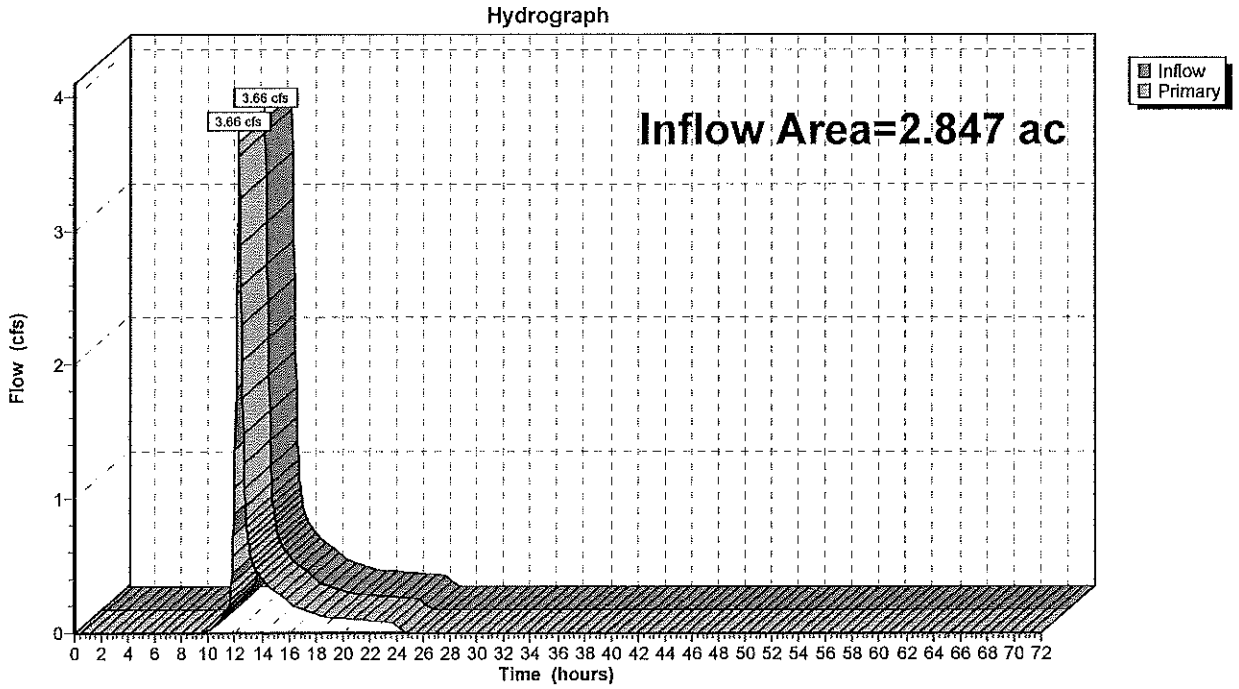
Summary for Pond AP-1: AP-1

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.847 ac, 14.56% Impervious, Inflow Depth = 1.55" for 10-Year event
Inflow = 3.66 cfs @ 12.22 hrs, Volume= 0.367 af
Primary = 3.66 cfs @ 12.22 hrs, Volume= 0.367 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Pond AP-1: AP-1



Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentEX-1: EX-1 Runoff Area=38,917 sf 2.32% Impervious Runoff Depth=1.96"
Tc=6.0 min CN=43 Runoff=1.72 cfs 0.146 af

SubcatchmentEX-2: EX-2 Runoff Area=85,117 sf 20.16% Impervious Runoff Depth=5.42"
Flow Length=708' Tc=14.9 min CN=72 Runoff=9.37 cfs 0.883 af

Pond AP-1: AP-1 Inflow=10.59 cfs 1.029 af
Primary=10.59 cfs 1.029 af

Total Runoff Area = 2.847 ac Runoff Volume = 1.029 af Average Runoff Depth = 4.33"
85.44% Pervious = 2.433 ac 14.56% Impervious = 0.415 ac

Summary for Subcatchment EX-1: EX-1

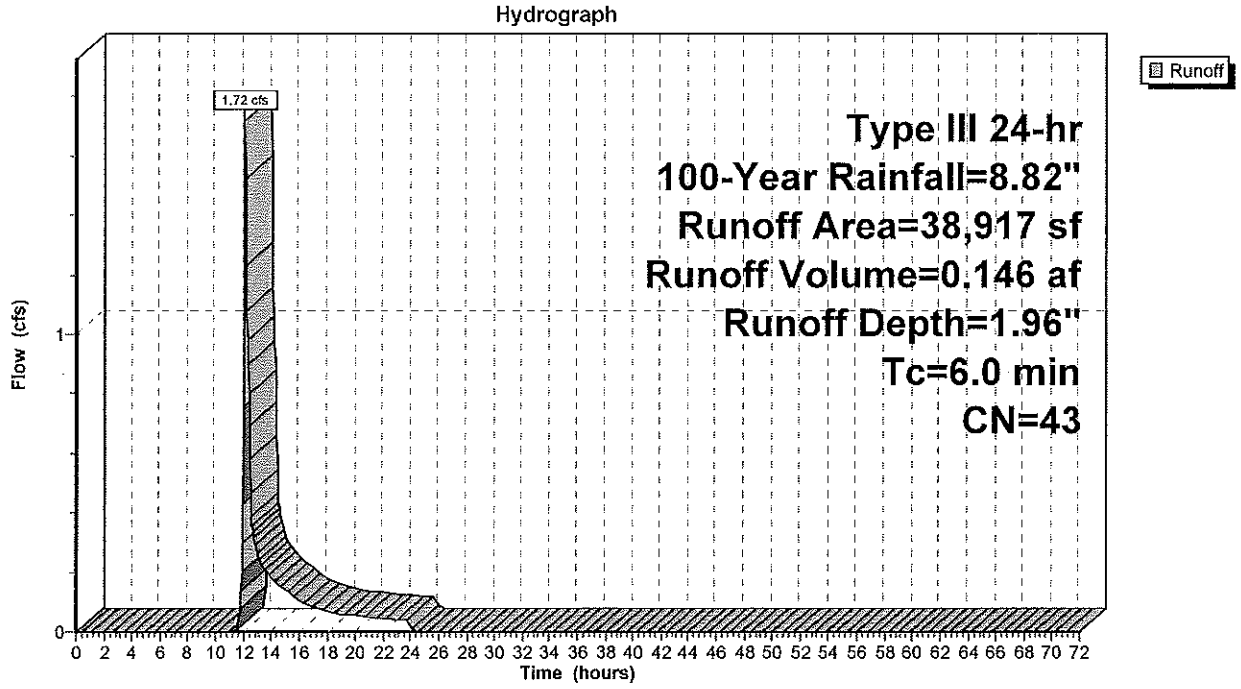
Runoff = 1.72 cfs @ 12.11 hrs, Volume= 0.146 af, Depth= 1.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.82"

Area (sf)	CN	Description
35,770	39	>75% Grass cover, Good, HSG A
492	61	>75% Grass cover, Good, HSG B
903	98	Paved parking, HSG A
1,752	96	Gravel surface, HSG A
38,917	43	Weighted Average
38,014		97.68% Pervious Area
903		2.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry,

Subcatchment EX-1: EX-1



Summary for Subcatchment EX-2: EX-2

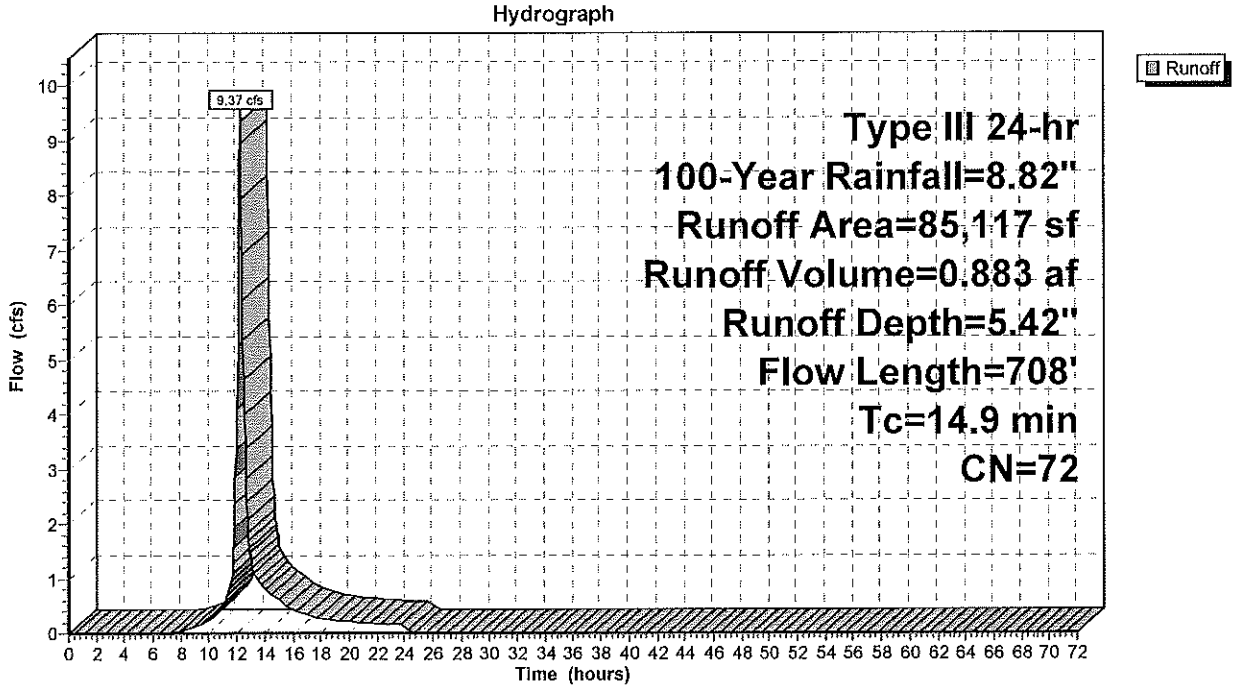
Runoff = 9.37 cfs @ 12.21 hrs, Volume= 0.883 af, Depth= 5.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.82"

Area (sf)	CN	Description
22,168	70	Woods, Good, HSG C
12,828	74	>75% Grass cover, Good, HSG C
3,081	98	Paved parking, HSG C
31,086	61	>75% Grass cover, Good, HSG B
10,575	98	Paved parking, HSG B
3,204	98	Roofs, HSG B
1,874	39	>75% Grass cover, Good, HSG A
301	98	Paved parking, HSG A
85,117	72	Weighted Average
67,956		79.84% Pervious Area
17,161		20.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.8	120	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.5	140	0.0600	4.97		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	120	0.0650	3.82		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.6	88	0.0300	2.60		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.0	190	0.0050	1.06		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
14.9	708	Total			

Subcatchment EX-2: EX-2



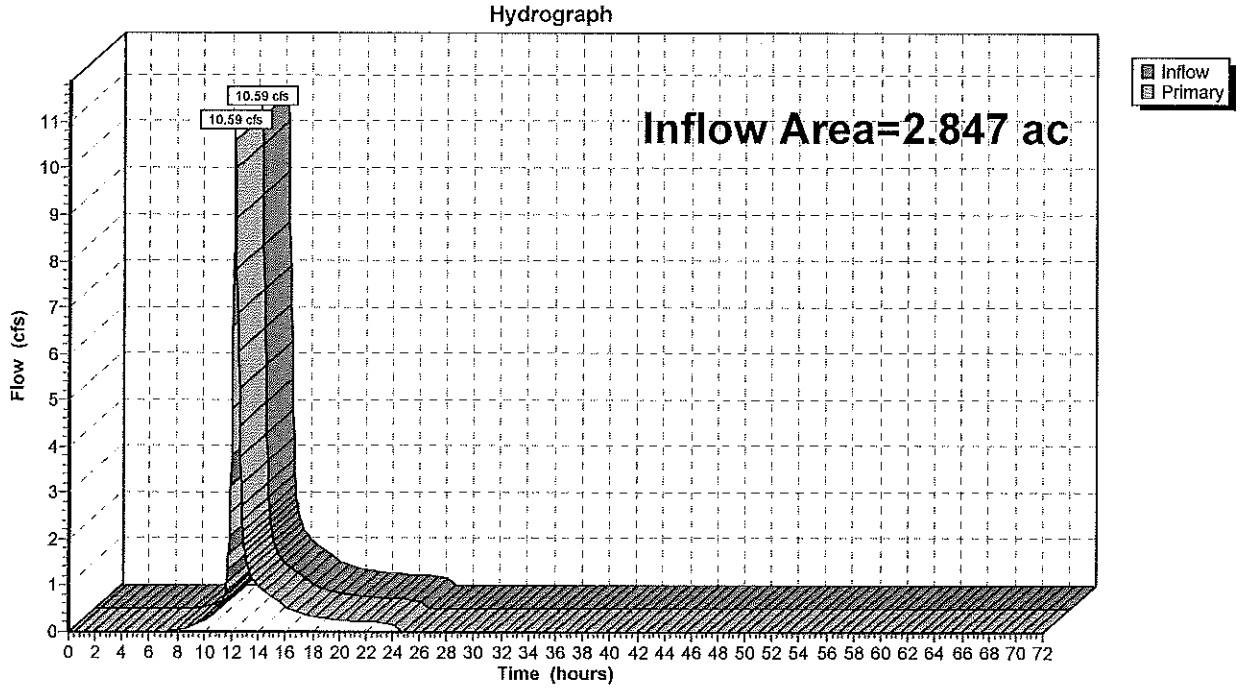
Summary for Pond AP-1: AP-1

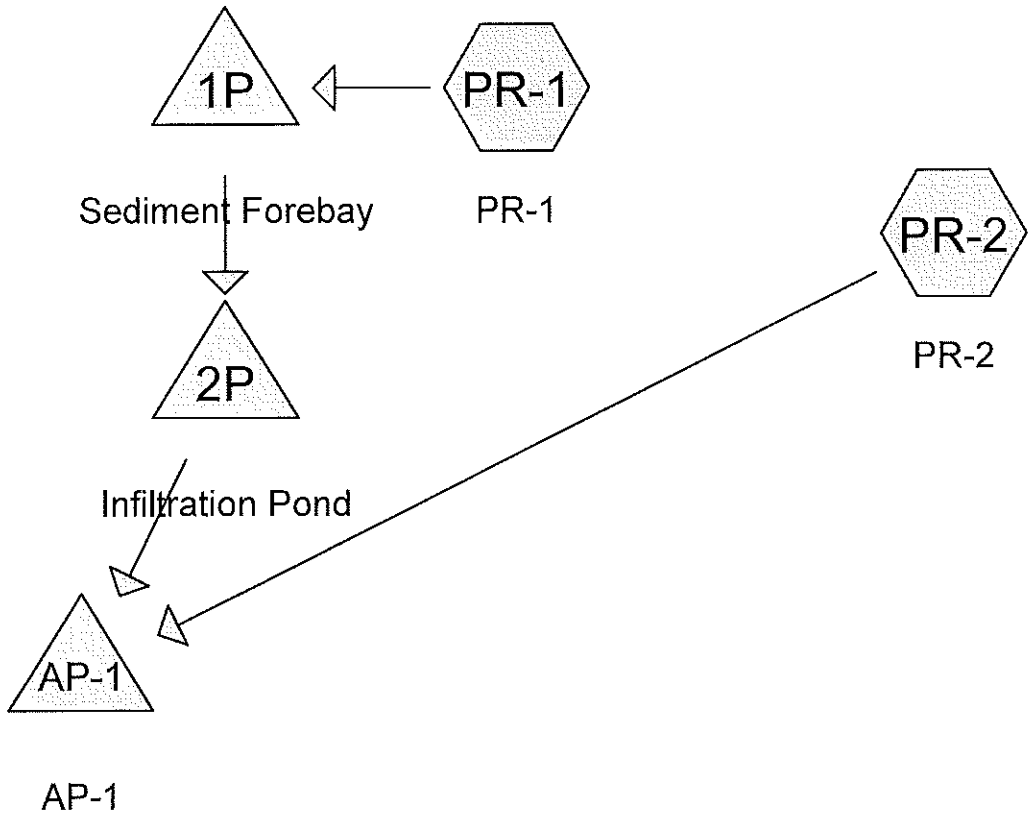
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.847 ac, 14.56% Impervious, Inflow Depth = 4.33" for 100-Year event
Inflow = 10.59 cfs @ 12.20 hrs, Volume= 1.029 af
Primary = 10.59 cfs @ 12.20 hrs, Volume= 1.029 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Pond AP-1: AP-1





Subcat Reach Pond Link

Routing Diagram for W2658-1 Post-Development rev1
Prepared by {enter your company name here}, Printed 12/9/2021

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.580	39	>75% Grass cover, Good, HSG A (PR-1, PR-2)
0.618	61	>75% Grass cover, Good, HSG B (PR-1, PR-2)
0.295	74	>75% Grass cover, Good, HSG C (PR-2)
0.233	98	Paved parking, HSG A (PR-1, PR-2)
0.262	98	Paved parking, HSG B (PR-1, PR-2)
0.071	98	Paved parking, HSG C (PR-2)
0.119	98	Roofs, HSG A (PR-1)
0.161	98	Roofs, HSG B (PR-1, PR-2)
0.509	70	Woods, Good, HSG C (PR-2)
2.847	**70**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.932	HSG A	PR-1, PR-2
1.041	HSG B	PR-1, PR-2
0.874	HSG C	PR-2
0.000	HSG D	
0.000	Other	
2.847		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.580	0.618	0.295	0.000	0.000	1.492	>75% Grass cover, Good	PR-1, PR-2
0.233	0.262	0.071	0.000	0.000	0.565	Paved parking	PR-1, PR-2
0.119	0.161	0.000	0.000	0.000	0.281	Roofs	PR-1, PR-2
0.000	0.000	0.509	0.000	0.000	0.509	Woods, Good	PR-2
0.932	**1.041**	**0.874**	**0.000**	**0.000**	**2.847**	**TOTAL AREA**	

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentPR-1: PR-1 Runoff Area=43,212 sf 45.58% Impervious Runoff Depth=0.66"
Tc=6.0 min CN=66 Runoff=0.63 cfs 0.055 af

SubcatchmentPR-2: PR-2 Runoff Area=80,821 sf 21.23% Impervious Runoff Depth=1.01"
Flow Length=708' Tc=14.9 min CN=73 Runoff=1.55 cfs 0.156 af

Pond 1P: Sediment Forebay Peak Elev=361.88' Storage=827 cf Inflow=0.63 cfs 0.055 af
Outflow=0.07 cfs 0.055 af

Pond 2P: Infiltration Pond Peak Elev=360.76' Storage=482 cf Inflow=0.07 cfs 0.055 af
Discarded=0.05 cfs 0.055 af Primary=0.00 cfs 0.000 af Outflow=0.05 cfs 0.055 af

Pond AP-1: AP-1 Inflow=1.55 cfs 0.156 af
Primary=1.55 cfs 0.156 af

Total Runoff Area = 2.847 ac Runoff Volume = 0.211 af Average Runoff Depth = 0.89"
70.28% Pervious = 2.001 ac 29.72% Impervious = 0.846 ac

Summary for Subcatchment PR-1: PR-1

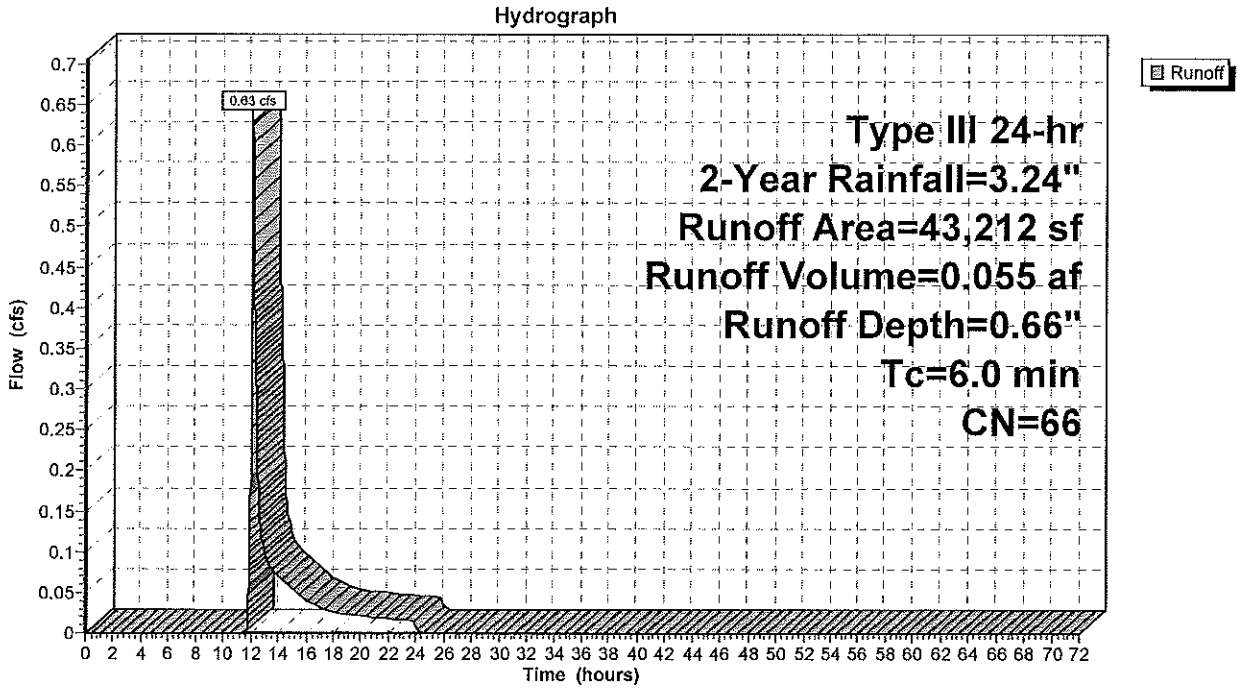
Runoff = 0.63 cfs @ 12.11 hrs, Volume= 0.055 af, Depth= 0.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.24"

Area (sf)	CN	Description
23,043	39	>75% Grass cover, Good, HSG A
472	61	>75% Grass cover, Good, HSG B
5,197	98	Roofs, HSG A
3,827	98	Roofs, HSG B
9,844	98	Paved parking, HSG A
829	98	Paved parking, HSG B
43,212	66	Weighted Average
23,515		54.42% Pervious Area
19,697		45.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment PR-1: PR-1



Summary for Subcatchment PR-2: PR-2

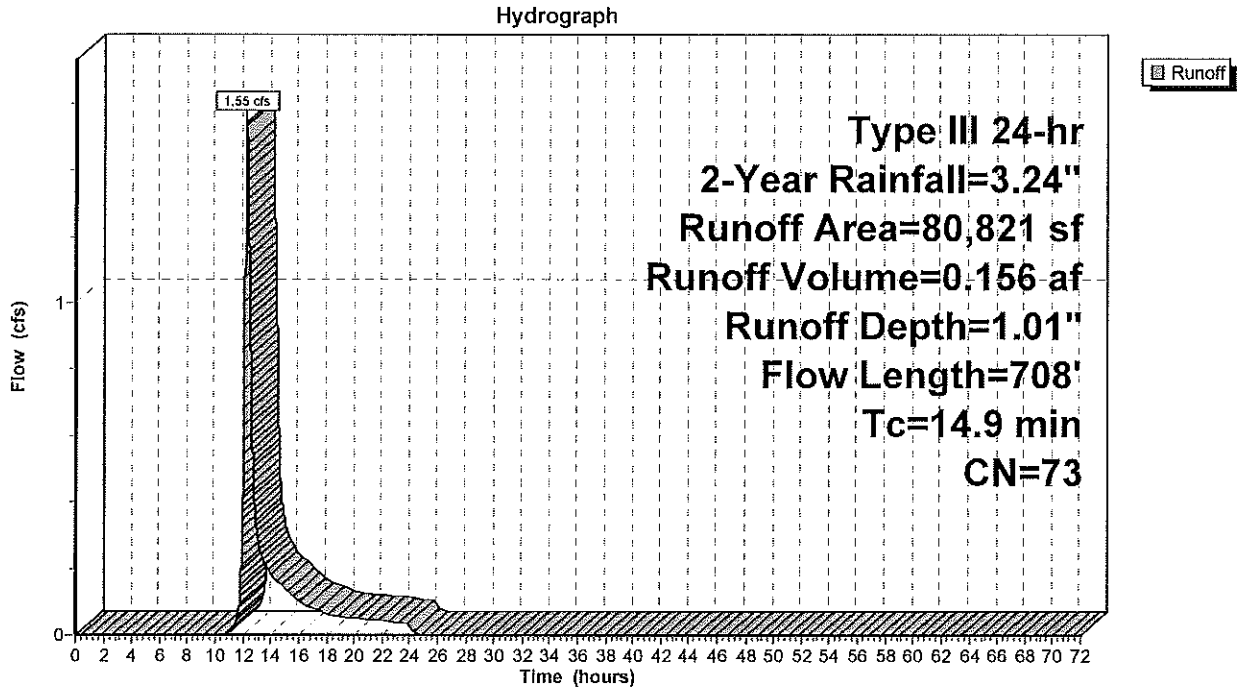
Runoff = 1.55 cfs @ 12.22 hrs, Volume= 0.156 af, Depth= 1.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.24"

Area (sf)	CN	Description
22,168	70	Woods, Good, HSG C
12,842	74	>75% Grass cover, Good, HSG C
3,081	98	Paved parking, HSG C
10,575	98	Paved parking, HSG B
26,448	61	>75% Grass cover, Good, HSG B
3,204	98	Roofs, HSG B
300	98	Paved parking, HSG A
2,203	39	>75% Grass cover, Good, HSG A
80,821	73	Weighted Average
63,661		78.77% Pervious Area
17,160		21.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.8	120	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.5	140	0.0600	4.97		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	120	0.0650	3.82		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.6	88	0.0300	2.60		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.0	190	0.0050	1.06		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
14.9	708	Total			

Subcatchment PR-2: PR-2



Summary for Pond 1P: Sediment Forebay

Inflow Area = 0.992 ac, 45.58% Impervious, Inflow Depth = 0.66" for 2-Year event
Inflow = 0.63 cfs @ 12.11 hrs, Volume= 0.055 af
Outflow = 0.07 cfs @ 12.80 hrs, Volume= 0.055 af, Atten= 88%, Lag= 41.8 min
Primary = 0.07 cfs @ 12.80 hrs, Volume= 0.055 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 361.88' @ 13.91 hrs Surf.Area= 628 sf Storage= 827 cf

Plug-Flow detention time= 176.2 min calculated for 0.055 af (100% of inflow)
Center-of-Mass det. time= 176.4 min (1,066.3 - 890.0)

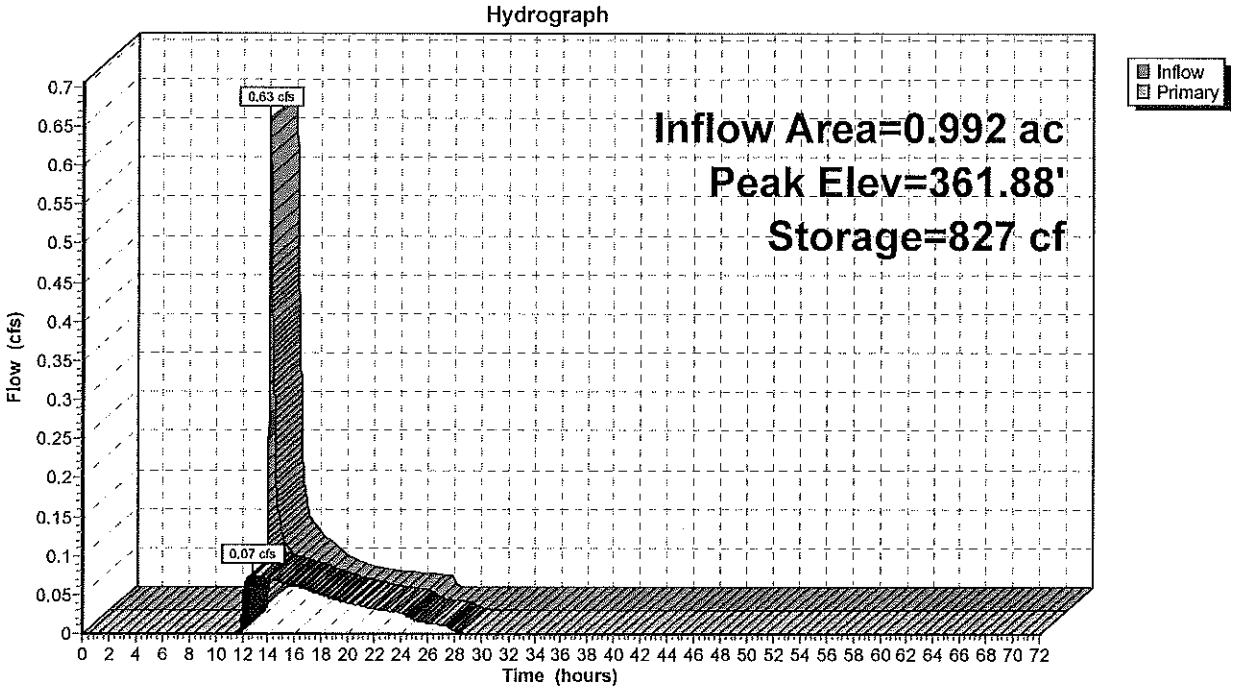
Volume	Invert	Avail.Storage	Storage Description
#1	360.00'	3,497 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
360.00	253	0	0
362.00	652	905	905
362.10	726	69	974
364.00	1,238	1,866	2,840
364.50	1,390	657	3,497

Device	Routing	Invert	Outlet Devices
#1	Primary	360.00'	**1.5" Vert. Orifice/Grate** C= 0.600
#2	Primary	362.00'	**5.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.07 cfs @ 12.80 hrs HW=361.79' TW=360.19' (Dynamic Tailwater)
↑—**1=Orifice/Grate** (Orifice Controls 0.07 cfs @ 6.09 fps)
└—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Sediment Forebay



Summary for Pond 2P: Infiltration Pond

Inflow Area = 0.992 ac, 45.58% Impervious, Inflow Depth = 0.66" for 2-Year event
Inflow = 0.07 cfs @ 12.80 hrs, Volume= 0.055 af
Outflow = 0.05 cfs @ 18.26 hrs, Volume= 0.055 af, Atten= 36%, Lag= 327.2 min
Discarded = 0.05 cfs @ 18.26 hrs, Volume= 0.055 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 360.76' @ 18.26 hrs Surf.Area= 740 sf Storage= 482 cf

Plug-Flow detention time= 123.2 min calculated for 0.055 af (100% of inflow)
Center-of-Mass det. time= 123.2 min (1,189.5 - 1,066.3)

Volume	Invert	Avail.Storage	Storage Description
#1	360.00'	5,534 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

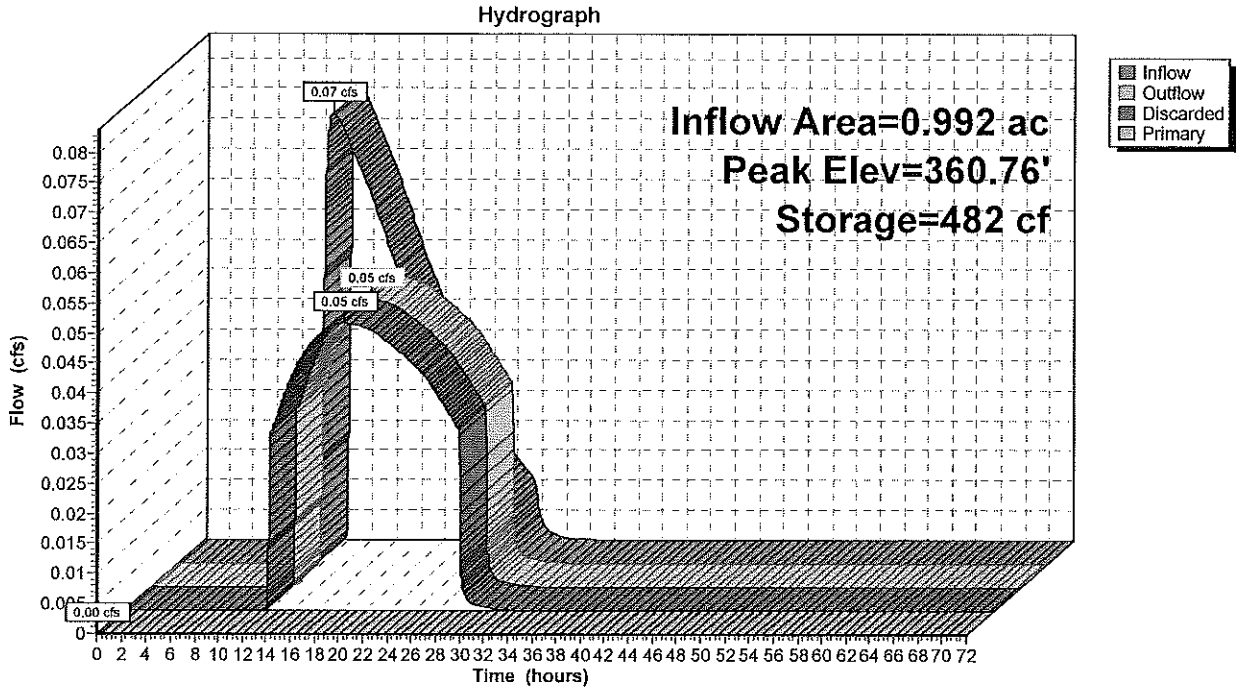
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
360.00	528	0	0
362.00	1,085	1,613	1,613
362.10	1,167	113	1,726
364.00	1,829	2,846	4,572
364.50	2,020	962	5,534

Device	Routing	Invert	Outlet Devices
#1	Primary	363.50'	**10.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	360.00'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 356.00' Phase-In= 0.01'

Discarded OutFlow Max=0.05 cfs @ 18.26 hrs HW=360.76' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.05 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=360.00' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Infiltration Pond



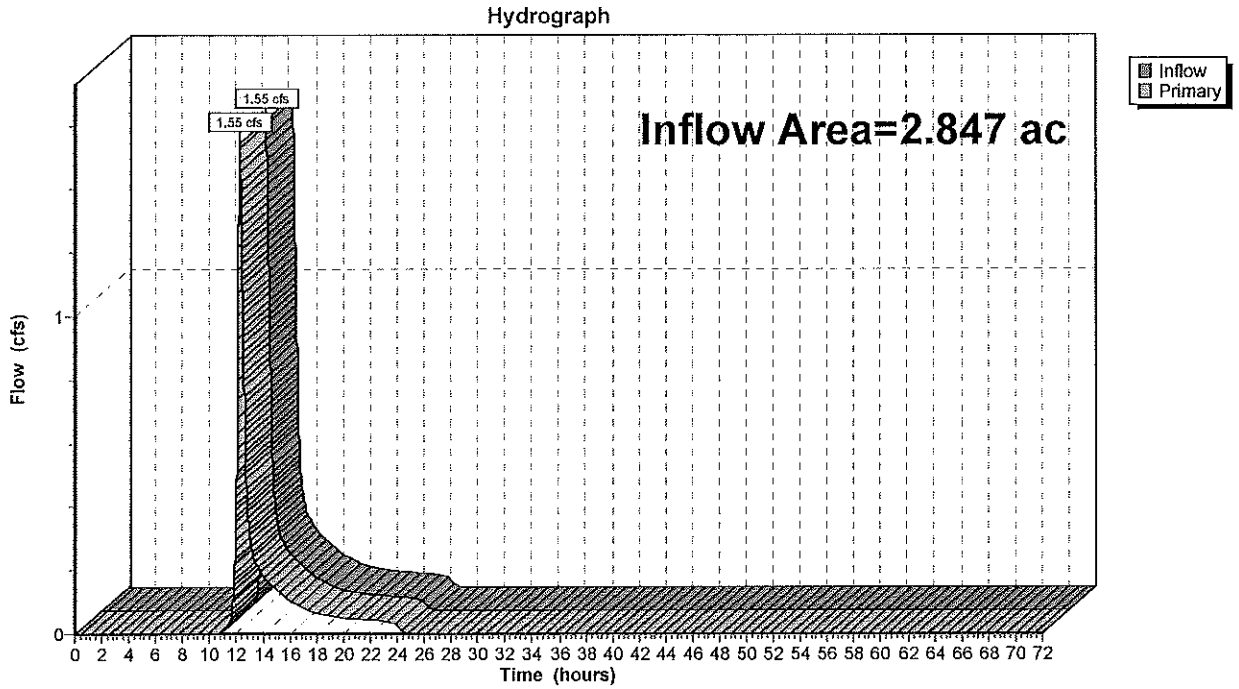
Summary for Pond AP-1: AP-1

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.847 ac, 29.72% Impervious, Inflow Depth = 0.66" for 2-Year event
Inflow = 1.55 cfs @ 12.22 hrs, Volume= 0.156 af
Primary = 1.55 cfs @ 12.22 hrs, Volume= 0.156 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-1: AP-1



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentPR-1: PR-1 Runoff Area=43,212 sf 45.58% Impervious Runoff Depth=1.65"
Tc=6.0 min CN=66 Runoff=1.83 cfs 0.136 af

SubcatchmentPR-2: PR-2 Runoff Area=80,821 sf 21.23% Impervious Runoff Depth=2.19"
Flow Length=708' Tc=14.9 min CN=73 Runoff=3.56 cfs 0.338 af

Pond 1P: Sediment Forebay Peak Elev=362.38' Storage=1,188 cf Inflow=1.83 cfs 0.136 af
Outflow=1.54 cfs 0.136 af

Pond 2P: Infiltration Pond Peak Elev=362.38' Storage=2,066 cf Inflow=1.54 cfs 0.136 af
Discarded=0.10 cfs 0.136 af Primary=0.00 cfs 0.000 af Outflow=0.10 cfs 0.136 af

Pond AP-1: AP-1 Inflow=3.56 cfs 0.338 af
Primary=3.56 cfs 0.338 af

Total Runoff Area = 2.847 ac Runoff Volume = 0.474 af Average Runoff Depth = 2.00"
70.28% Pervious = 2.001 ac 29.72% Impervious = 0.846 ac

Summary for Subcatchment PR-1: PR-1

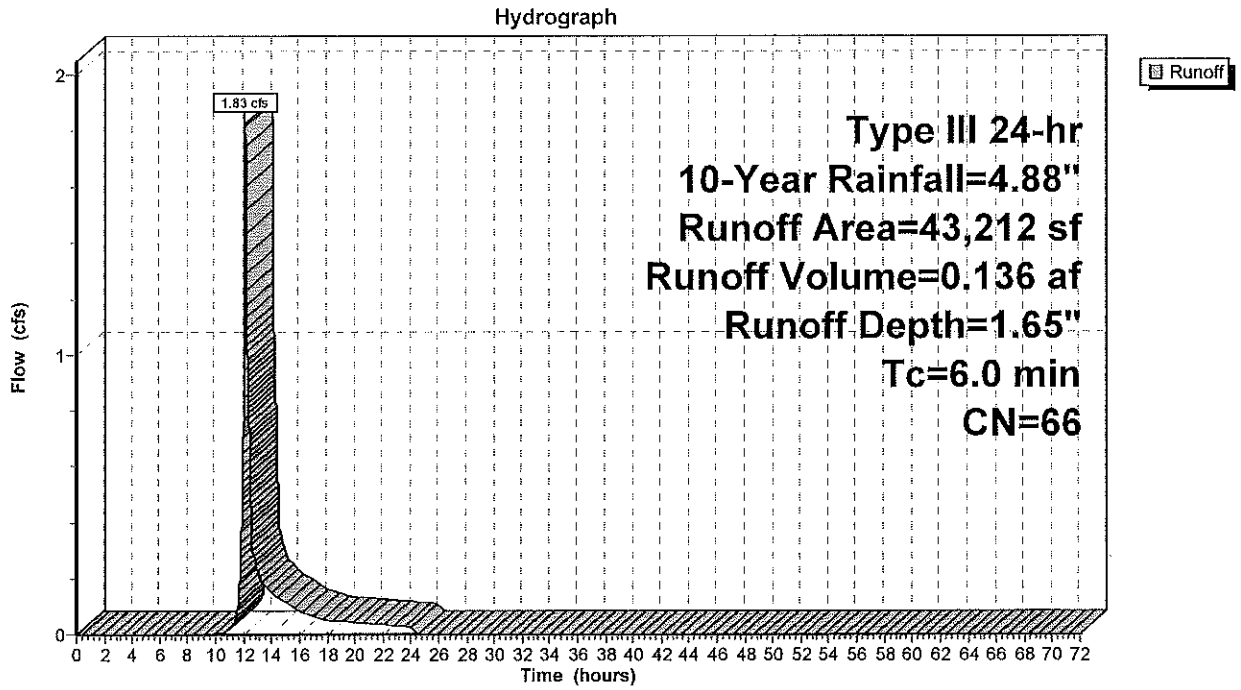
Runoff = 1.83 cfs @ 12.10 hrs, Volume= 0.136 af, Depth= 1.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.88"

Area (sf)	CN	Description
23,043	39	>75% Grass cover, Good, HSG A
472	61	>75% Grass cover, Good, HSG B
5,197	98	Roofs, HSG A
3,827	98	Roofs, HSG B
9,844	98	Paved parking, HSG A
829	98	Paved parking, HSG B
43,212	66	Weighted Average
23,515		54.42% Pervious Area
19,697		45.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment PR-1: PR-1



Summary for Subcatchment PR-2: PR-2

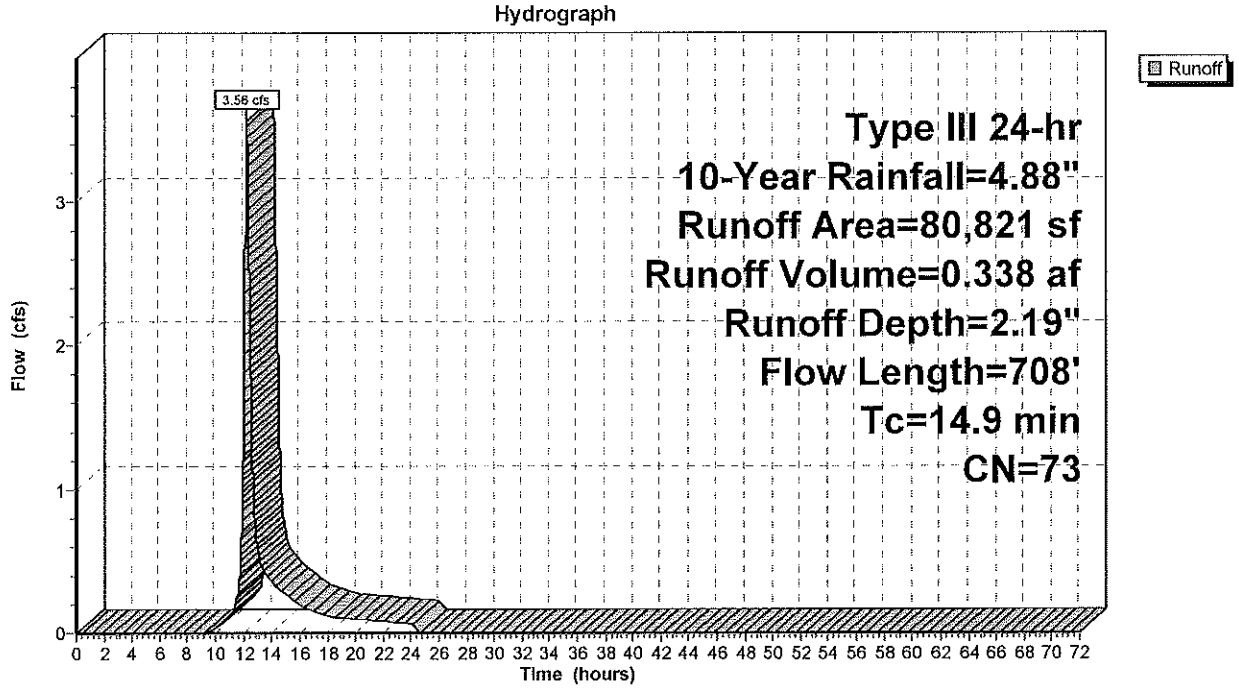
Runoff = 3.56 cfs @ 12.21 hrs, Volume= 0.338 af, Depth= 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.88"

Area (sf)	CN	Description
22,168	70	Woods, Good, HSG C
12,842	74	>75% Grass cover, Good, HSG C
3,081	98	Paved parking, HSG C
10,575	98	Paved parking, HSG B
26,448	61	>75% Grass cover, Good, HSG B
3,204	98	Roofs, HSG B
300	98	Paved parking, HSG A
2,203	39	>75% Grass cover, Good, HSG A
80,821	73	Weighted Average
63,661		78.77% Pervious Area
17,160		21.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.8	120	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.5	140	0.0600	4.97		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	120	0.0650	3.82		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.6	88	0.0300	2.60		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.0	190	0.0050	1.06		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
14.9	708	Total			

Subcatchment PR-2: PR-2



Summary for Pond 1P: Sediment Forebay

Inflow Area = 0.992 ac, 45.58% Impervious, Inflow Depth = 1.65" for 10-Year event
Inflow = 1.83 cfs @ 12.10 hrs, Volume= 0.136 af
Outflow = 1.54 cfs @ 12.15 hrs, Volume= 0.136 af, Atten= 16%, Lag= 3.2 min
Primary = 1.54 cfs @ 12.15 hrs, Volume= 0.136 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 362.38' @ 15.57 hrs Surf.Area= 802 sf Storage= 1,188 cf

Plug-Flow detention time= 170.7 min calculated for 0.136 af (100% of inflow)
Center-of-Mass det. time= 170.8 min (1,030.5 - 859.6)

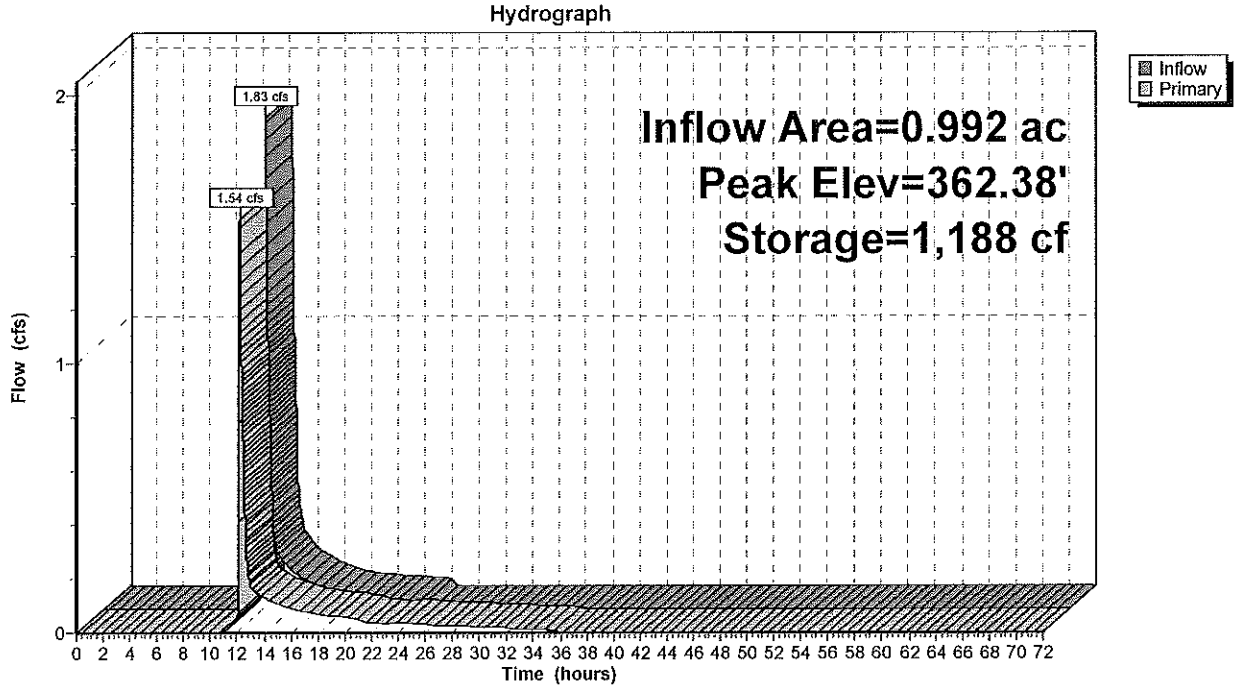
Volume	Invert	Avail.Storage	Storage Description
#1	360.00'	3,497 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
360.00	253	0	0
362.00	652	905	905
362.10	726	69	974
364.00	1,238	1,866	2,840
364.50	1,390	657	3,497

Device	Routing	Invert	Outlet Devices
#1	Primary	360.00'	**1.5" Vert. Orifice/Grate** C= 0.600
#2	Primary	362.00'	**5.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=1.54 cfs @ 12.15 hrs HW=362.24' TW=360.49' (Dynamic Tailwater)
↑—**1=Orifice/Grate** (Orifice Controls 0.08 cfs @ 6.38 fps)
└—**2=Broad-Crested Rectangular Weir** (Weir Controls 1.46 cfs @ 1.19 fps)

Pond 1P: Sediment Forebay



Summary for Pond 2P: Infiltration Pond

Inflow Area = 0.992 ac, 45.58% Impervious, Inflow Depth = 1.65" for 10-Year event
Inflow = 1.54 cfs @ 12.15 hrs, Volume= 0.136 af
Outflow = 0.10 cfs @ 15.56 hrs, Volume= 0.136 af, Atten= 94%, Lag= 204.5 min
Discarded = 0.10 cfs @ 15.56 hrs, Volume= 0.136 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 362.38' @ 15.56 hrs Surf.Area= 1,265 sf Storage= 2,066 cf

Plug-Flow detention time= 275.2 min calculated for 0.136 af (100% of inflow)
Center-of-Mass det. time= 275.1 min (1,305.6 - 1,030.5)

Volume	Invert	Avail.Storage	Storage Description
#1	360.00'	5,534 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

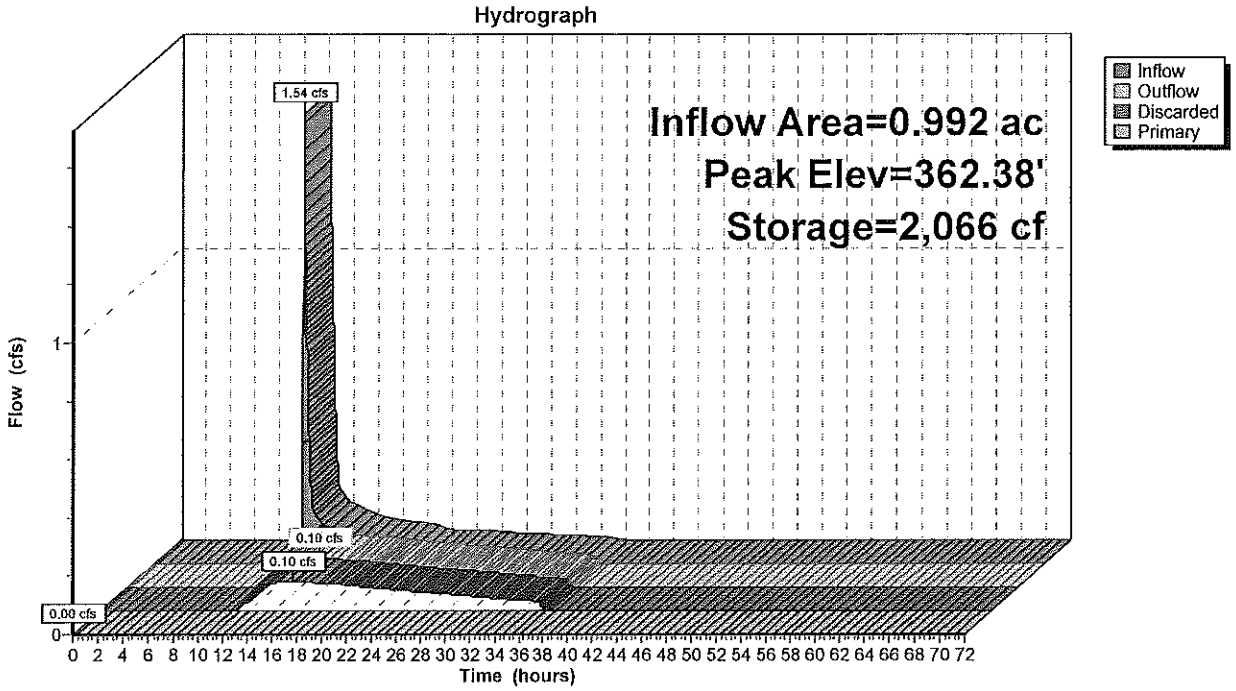
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
360.00	528	0	0
362.00	1,085	1,613	1,613
362.10	1,167	113	1,726
364.00	1,829	2,846	4,572
364.50	2,020	962	5,534

Device	Routing	Invert	Outlet Devices
#1	Primary	363.50'	**10.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	360.00'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 356.00' Phase-In= 0.01'

Discarded OutFlow Max=0.10 cfs @ 15.56 hrs HW=362.38' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.10 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=360.00' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Infiltration Pond



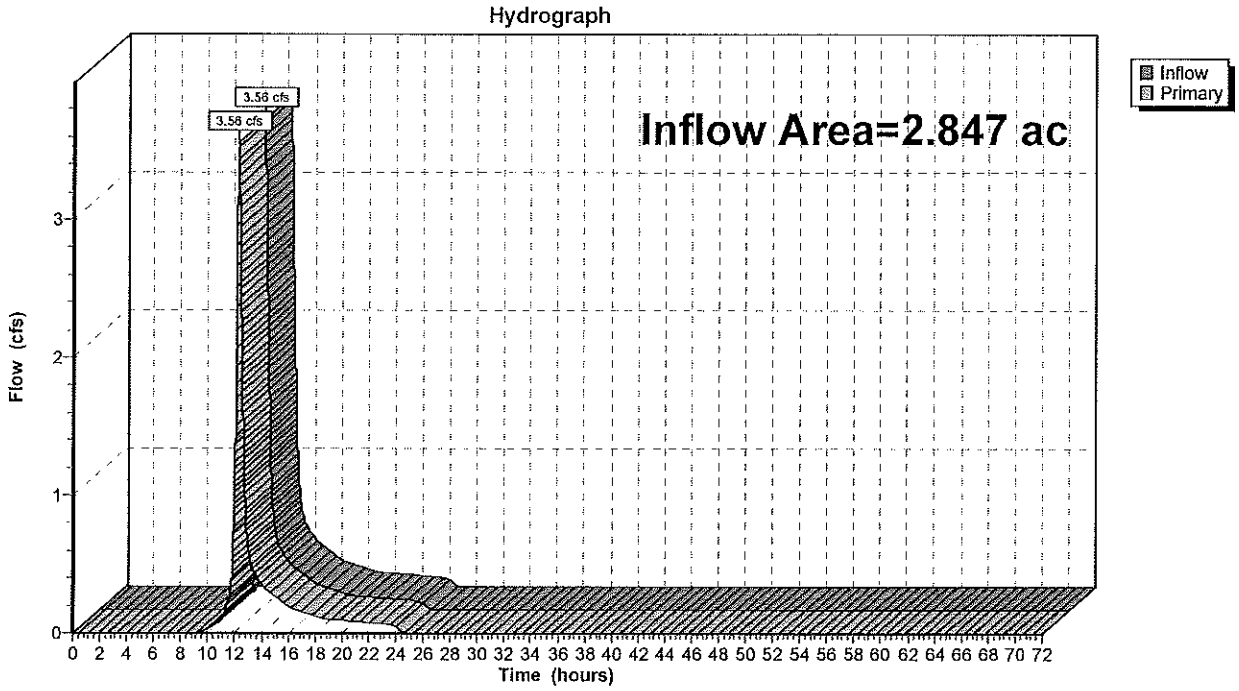
Summary for Pond AP-1: AP-1

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.847 ac, 29.72% Impervious, Inflow Depth = 1.42" for 10-Year event
Inflow = 3.56 cfs @ 12.21 hrs, Volume= 0.338 af
Primary = 3.56 cfs @ 12.21 hrs, Volume= 0.338 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-1: AP-1



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentPR-1: PR-1 Runoff Area=43,212 sf 45.58% Impervious Runoff Depth=4.69"
Tc=6.0 min CN=66 Runoff=5.46 cfs 0.388 af

SubcatchmentPR-2: PR-2 Runoff Area=80,821 sf 21.23% Impervious Runoff Depth=5.54"
Flow Length=708' Tc=14.9 min CN=73 Runoff=9.14 cfs 0.857 af

Pond 1P: Sediment Forebay Peak Elev=363.69' Storage=2,468 cf Inflow=5.46 cfs 0.388 af
Outflow=3.49 cfs 0.388 af

Pond 2P: Infiltration Pond Peak Elev=363.69' Storage=4,017 cf Inflow=3.49 cfs 0.388 af
Discarded=0.15 cfs 0.258 af Primary=2.18 cfs 0.130 af Outflow=2.32 cfs 0.388 af

Pond AP-1: AP-1 Inflow=10.51 cfs 0.987 af
Primary=10.51 cfs 0.987 af

Total Runoff Area = 2.847 ac Runoff Volume = 1.245 af Average Runoff Depth = 5.25"
70.28% Pervious = 2.001 ac 29.72% Impervious = 0.846 ac

Summary for Subcatchment PR-1: PR-1

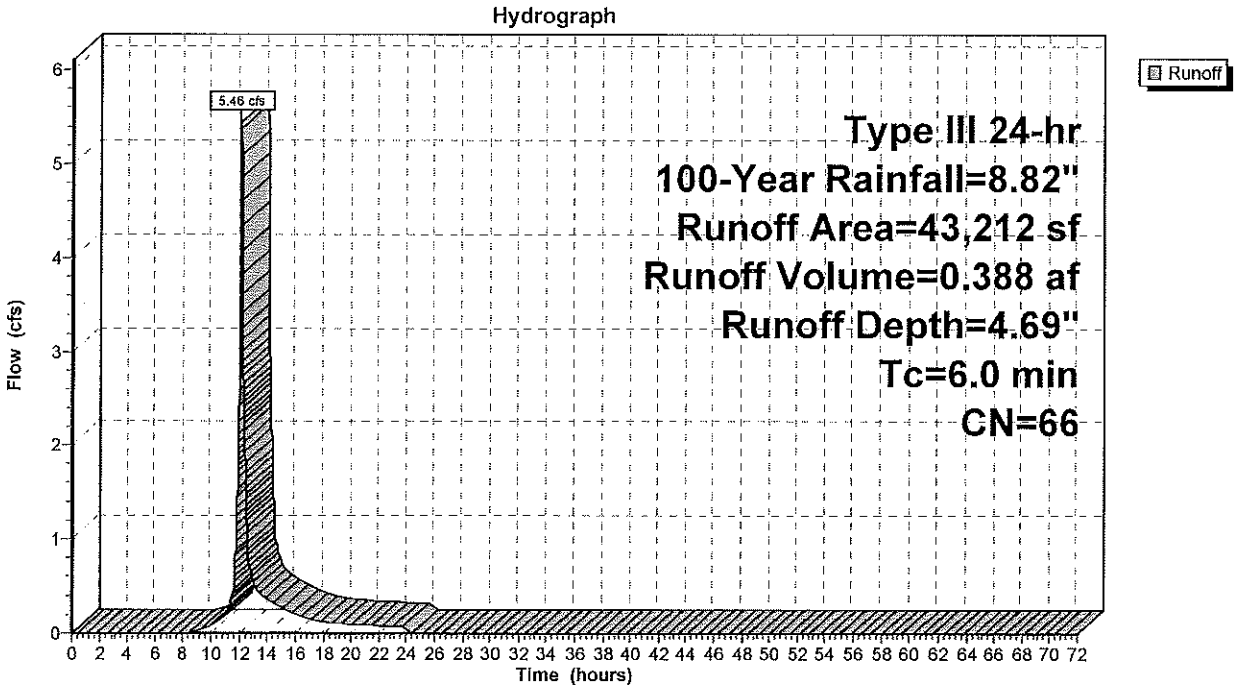
Runoff = 5.46 cfs @ 12.09 hrs, Volume= 0.388 af, Depth= 4.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.82"

Area (sf)	CN	Description
23,043	39	>75% Grass cover, Good, HSG A
472	61	>75% Grass cover, Good, HSG B
5,197	98	Roofs, HSG A
3,827	98	Roofs, HSG B
9,844	98	Paved parking, HSG A
829	98	Paved parking, HSG B
43,212	66	Weighted Average
23,515		54.42% Pervious Area
19,697		45.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment PR-1: PR-1



Summary for Subcatchment PR-2: PR-2

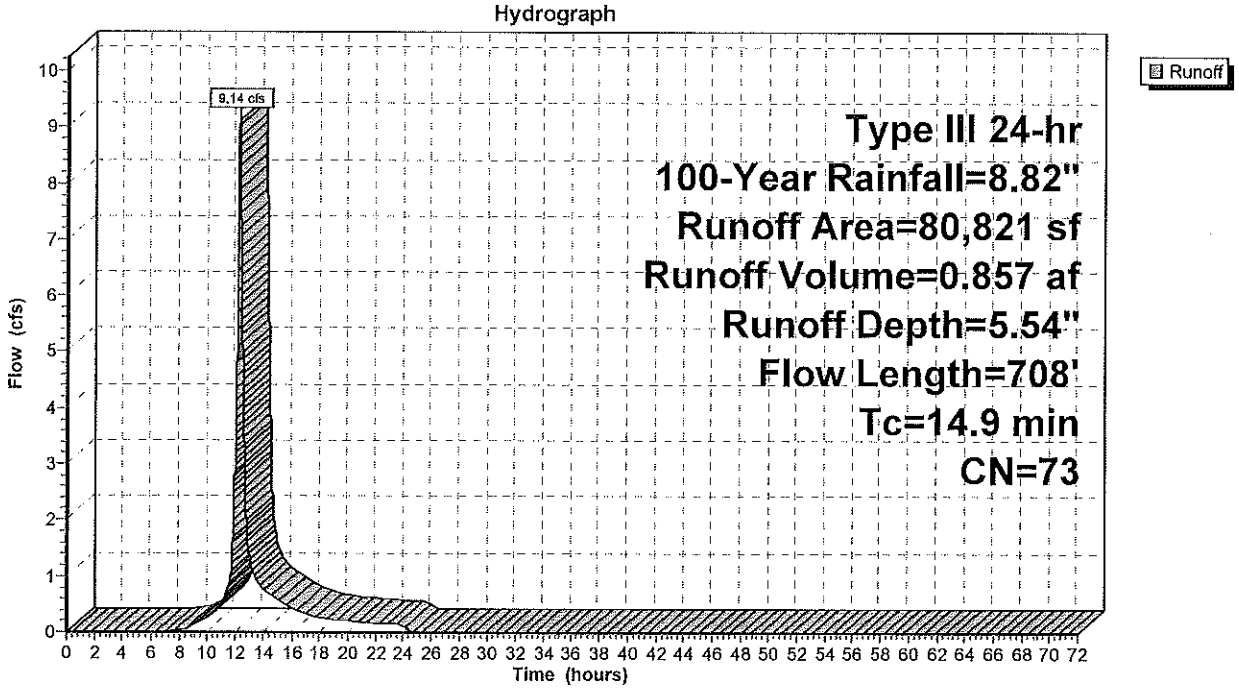
Runoff = 9.14 cfs @ 12.20 hrs, Volume= 0.857 af, Depth= 5.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.82"

Area (sf)	CN	Description
22,168	70	Woods, Good, HSG C
12,842	74	>75% Grass cover, Good, HSG C
3,081	98	Paved parking, HSG C
10,575	98	Paved parking, HSG B
26,448	61	>75% Grass cover, Good, HSG B
3,204	98	Roofs, HSG B
300	98	Paved parking, HSG A
2,203	39	>75% Grass cover, Good, HSG A
80,821	73	Weighted Average
63,661		78.77% Pervious Area
17,160		21.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.8	120	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.5	140	0.0600	4.97		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	120	0.0650	3.82		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.6	88	0.0300	2.60		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.0	190	0.0050	1.06		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
14.9	708	Total			

Subcatchment PR-2: PR-2



Summary for Pond 1P: Sediment Forebay

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=66)

Inflow Area = 0.992 ac, 45.58% Impervious, Inflow Depth = 4.69" for 100-Year event
Inflow = 5.46 cfs @ 12.09 hrs, Volume= 0.388 af
Outflow = 3.49 cfs @ 12.08 hrs, Volume= 0.388 af, Atten= 36%, Lag= 0.0 min
Primary = 3.49 cfs @ 12.08 hrs, Volume= 0.388 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 363.69' @ 12.32 hrs Surf.Area= 1,154 sf Storage= 2,468 cf

Plug-Flow detention time= 149.1 min calculated for 0.388 af (100% of inflow)
Center-of-Mass det. time= 149.0 min (977.7 - 828.7)

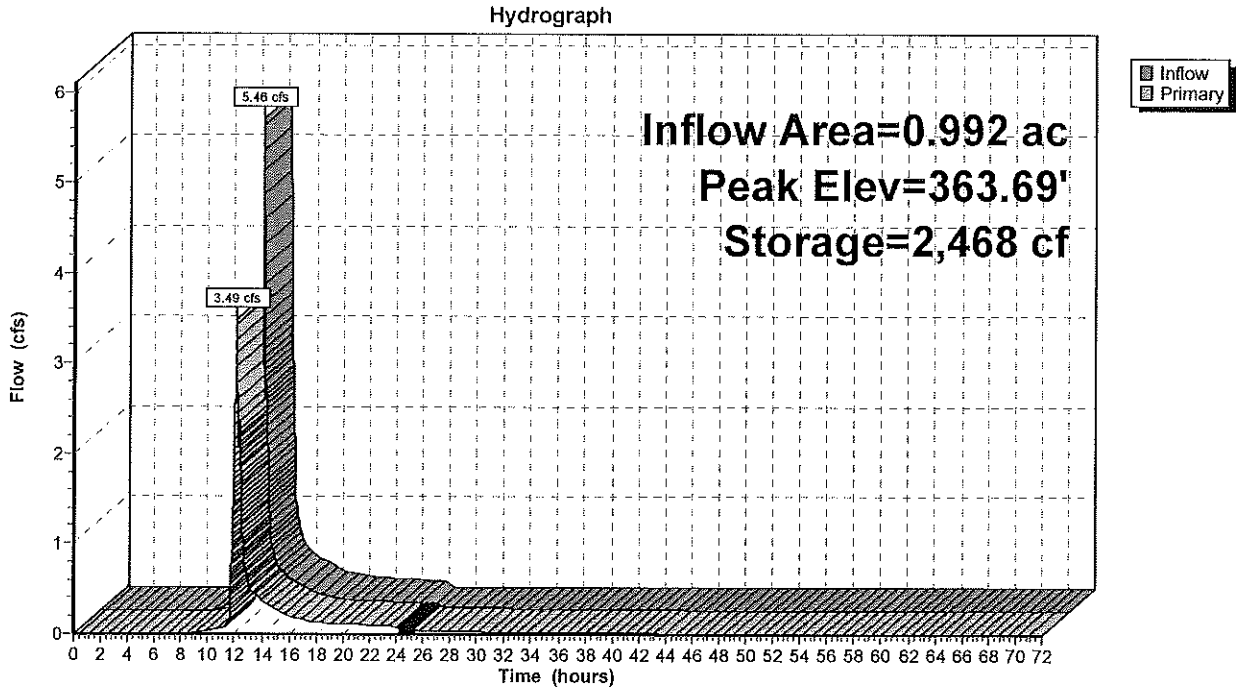
Volume	Invert	Avail.Storage	Storage Description
#1	360.00'	3,497 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
360.00	253	0	0
362.00	652	905	905
362.10	726	69	974
364.00	1,238	1,866	2,840
364.50	1,390	657	3,497

Device	Routing	Invert	Outlet Devices
#1	Primary	360.00'	**1.5" Vert. Orifice/Grate** C= 0.600
#2	Primary	362.00'	**5.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 12.08 hrs HW=362.81' TW=362.85' (Dynamic Tailwater)
↑—**1=Orifice/Grate** (Controls 0.00 cfs)
└—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Sediment Forebay



Summary for Pond 2P: Infiltration Pond

[80] Warning: Exceeded Pond 1P by 0.06' @ 12.11 hrs (5.86 cfs 0.105 af)

Inflow Area =	0.992 ac,	45.58% Impervious,	Inflow Depth =	4.69" for 100-Year event
Inflow =	3.49 cfs @	12.08 hrs, Volume=	0.388 af	
Outflow =	2.32 cfs @	12.31 hrs, Volume=	0.388 af,	Atten= 33%, Lag= 13.9 min
Discarded =	0.15 cfs @	12.31 hrs, Volume=	0.258 af	
Primary =	2.18 cfs @	12.31 hrs, Volume=	0.130 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 363.69' @ 12.31 hrs Surf.Area= 1,720 sf Storage= 4,017 cf

Plug-Flow detention time= 241.3 min calculated for 0.388 af (100% of inflow)
Center-of-Mass det. time= 241.3 min (1,219.0 - 977.7)

Volume	Invert	Avail.Storage	Storage Description
#1	360.00'	5,534 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

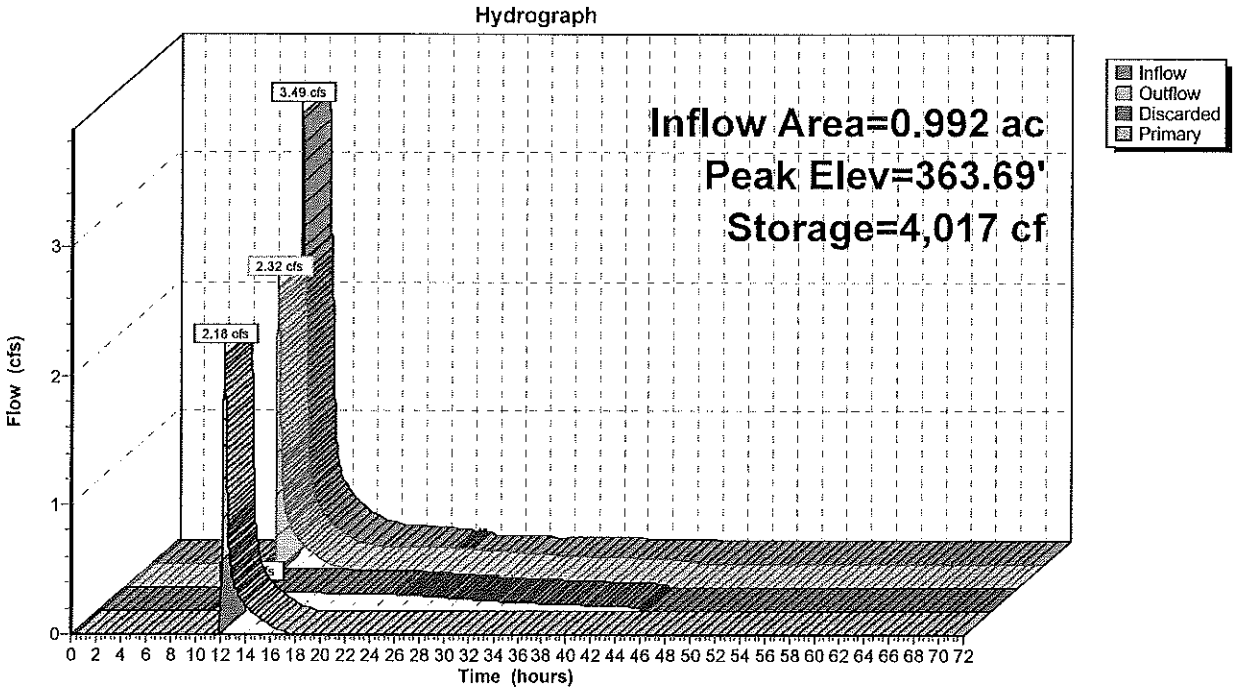
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
360.00	528	0	0
362.00	1,085	1,613	1,613
362.10	1,167	113	1,726
364.00	1,829	2,846	4,572
364.50	2,020	962	5,534

Device	Routing	Invert	Outlet Devices
#1	Primary	363.50'	**10.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	360.00'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 356.00' Phase-In= 0.01'

Discarded OutFlow Max=0.15 cfs @ 12.31 hrs HW=363.69' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.15 cfs)

Primary OutFlow Max=2.17 cfs @ 12.31 hrs HW=363.69' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 2.17 cfs @ 1.16 fps)

Pond 2P: Infiltration Pond



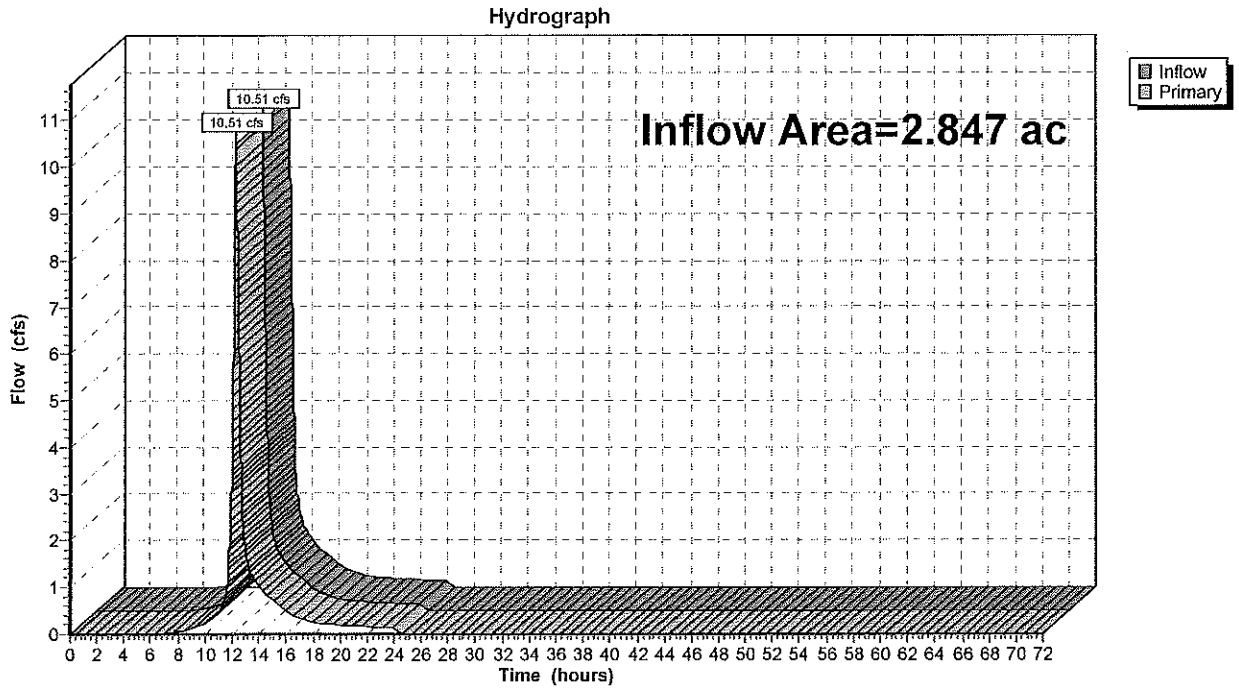
Summary for Pond AP-1: AP-1

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.847 ac, 29.72% Impervious, Inflow Depth = 4.16" for 100-Year event
Inflow = 10.51 cfs @ 12.24 hrs, Volume= 0.987 af
Primary = 10.51 cfs @ 12.24 hrs, Volume= 0.987 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-1: AP-1



Land Use Coefficients "C"

Pave	0.90
Gravel	0.80
Wetland	0.72
Grass	0.30
Woods	0.25
Roof	0.90

Drainage Area	Land Use Area Impervious (acres)	Gravel (acres)	Wetland (acres)	Pervious (acres)	Woods (acres)	Roof (acres)	Total (acres)	Weighted "C"
CB-1&2	0.119			0.080	0.000	0.000	0.199	0.66
CB-3	0.067			0.030	0.000	0.000	0.097	0.72
ROOF WEST	0.102			0.000	0.000	0.000	0.102	0.90
ROOF EAST	0.102			0.000	0.000	0.000	0.102	0.90
SUBTOTAL	0.390			0.110		0.000	0.500	
OVERALL TOTALS	0.390			0.110		0.000	0.500	

Guerriere & Halnon, Inc.
55 West Central Steet
Franklin, MA 01757-0235

Project: Afonso Village II
Job No.: W-2658-2

DESIGN COMPUTATIONS FOR STORM DRAINS

Prepared By: MAH Date: 12-28-2021 Revised
Checked By: Date: Revised

Drainage Area	Upper Structure	Lower Structure	Sum of CA's	Time of Concentration (Tc)	Rainfall Intensity (I)	Actual Peak Flow Rate (Q)	Pipe Diameter	Slope	Roughness Coefficient (n)	Design Flow Full (Q)	Velocity Flow Full (V)	Actual Velocity (V)	Length of Pipe (L)*	Time in pipe	Total Fall	Invert Elevation		Rim Elev		Destination
																Elev.	Elev.	Elev.	Elev.	
			(sf)	(min)	(in/hr)	(cfs)	(in)	(ft/ft)		(cfs)	(fps)	(fps)	(ft)	(min)	(ft)	Upper End	Lower End	Upper End	Lower End	
CB-1	CB-1&2	DMH-1	0.13	6.00	5.80	0.76	12	0.008	0.013	3.12	3.98	0.97	14.3	0.06	0.11	363.62	363.51	368.00	368.15	
	DMH-1	DMH-2	0.13	6.06	5.80	0.76	12	0.010	0.013	3.58	4.56	0.97	142.5	0.52	1.44	363.41	361.97	368.15	369.50	
CB-3	CB-3	DMH-2	0.07	6.00	5.80	0.40	12	0.010	0.013	3.65	4.64	0.51	21.0	0.08	0.22	364.01	363.79	368.50	369.50	
	DMH-2	DMH-3	0.29	6.91	5.69	1.66	12	0.010	0.013	3.59	4.56	2.12	71.1	0.26	0.72	361.87	361.15	369.50	364.75	Infiltration Basin
	DMH-3	HW-1	0.29	7.17	5.59	1.63	12	0.010	0.013	3.62	4.61	2.08	53.2	0.19	0.55	361.05	360.50	364.75	0.00	
ROOF WEST	ROOF WEST	HW-2	0.09	6.00	5.80	0.53	8	0.010	0.013	1.20	3.45	1.52	100.6	0.49	1.00	362.00	361.00	0.00	0.00	
ROOF EAST	ROOF EAST	DMH-2	0.09	6.00	5.80	0.53	8	0.014	0.013	1.45	4.15	1.52	211.0	0.85	3.03	365.00	361.97	0.00	0.00	

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: Afonso Village II, Grafton, MA

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Infiltration Basin	0.80	0.75	0.60	0.15

Total TSS Removal = 85%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: W-2658-2

Prepared By: Michael Hassett

Date: 6/1/2021

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: Afonso Village II, Grafton, MA

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Sediment Forebay	0.25	0.75	0.19	0.56

Infiltration Basin Pretreatment

Total TSS Removal = 44%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: W-2658-2

Prepared By: Michael Hassett

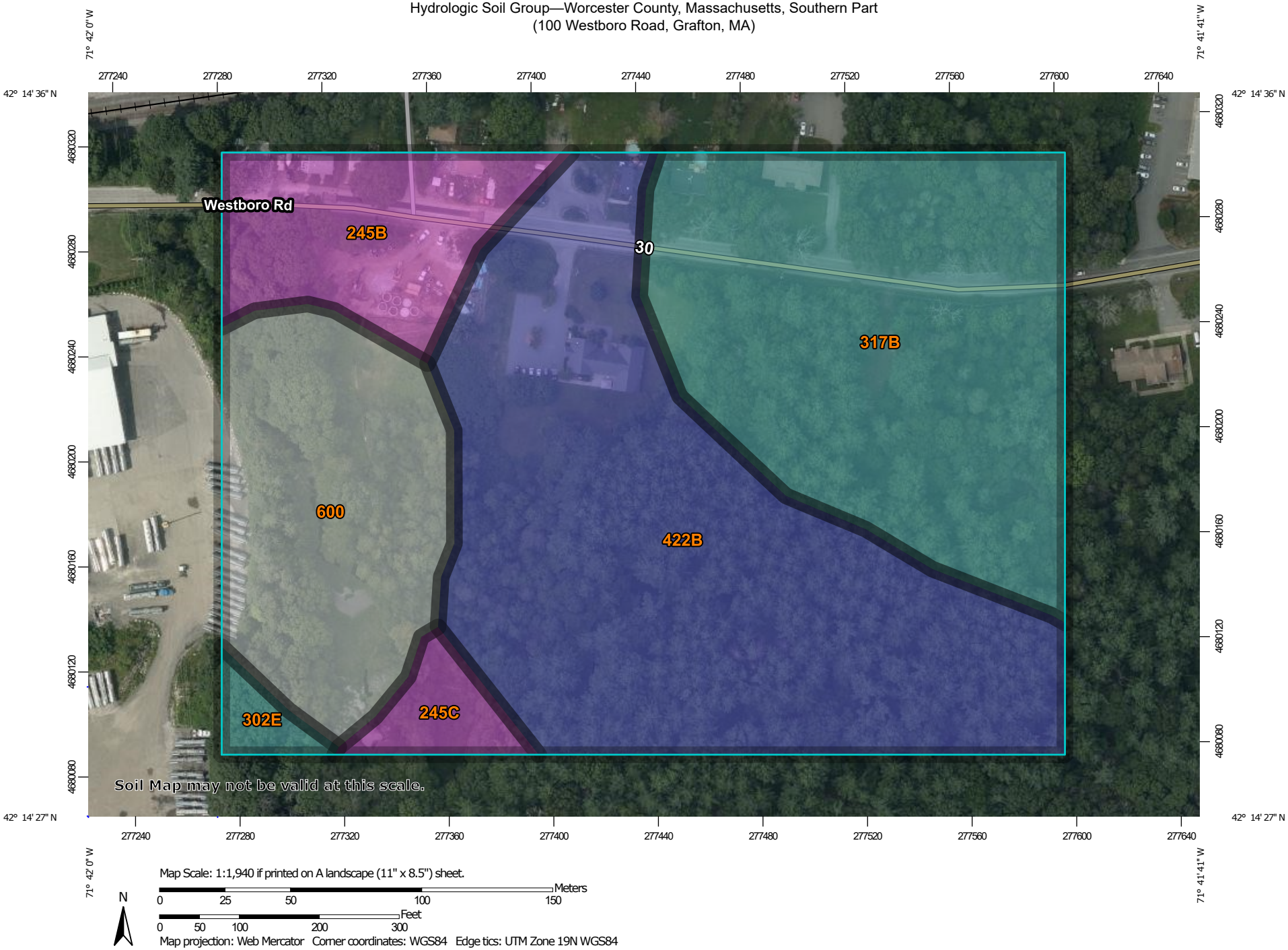
Date: 6/1/2021

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

Hydrologic Soil Group—Worcester County, Massachusetts, Southern Part
(100 Westboro Road, Grafton, MA)



Map Scale: 1:1,940 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 25 50 100 150

Feet
0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 13, Jun 11, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 26, 2019—Oct 5, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
245B	Hinckley loamy sand, 3 to 8 percent slopes	A	1.7	9.4%
245C	Hinckley loamy sand, 8 to 15 percent slopes	A	0.5	2.5%
302E	Montauk fine sandy loam, 15 to 35 percent slopes, extremely stony	C	0.2	1.3%
317B	Scituate fine sandy loam, 3 to 8 percent slopes, extremely stony	C	5.5	29.9%
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony	B	7.5	40.6%
600	Pits, gravel		3.0	16.3%
Totals for Area of Interest			**18.4**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Component

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Dominant Component" returns the attribute value associated with the component with the highest percent composition in the map unit. If more than one component shares the highest percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher attribute value should be returned in the case of a percent composition tie. The result returned by this aggregation method may or may not represent the dominant condition throughout the map unit.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Hydrograph for Pond 2P: Infiltration Pond

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	360.00	0.00	0.00	0.00
2.00	0.00	0	360.00	0.00	0.00	0.00
4.00	0.00	0	360.00	0.00	0.00	0.00
6.00	0.00	0	360.00	0.00	0.00	0.00
8.00	0.00	0	360.00	0.00	0.00	0.00
10.00	0.04	11	360.02	0.03	0.03	0.00
12.00	**2.22**	**1,968**	**362.30**	**0.09**	**0.09**	**0.00**
14.00	**0.36**	**3,770**	**363.54**	**0.37**	**0.14**	**0.23**
16.00	0.19	3,730	363.52	0.20	0.14	0.06
18.00	0.16	3,690	363.49	0.14	0.14	0.00
20.00	0.04	3,549	363.41	0.13	0.13	0.00
22.00	0.10	3,347	363.28	0.13	0.13	0.00
24.00	0.15	3,099	363.12	0.12	0.12	0.00
26.00	0.05	2,594	362.78	0.11	0.11	0.00
28.00	0.03	2,132	362.43	0.10	0.10	0.00
30.00	0.03	1,719	362.09	0.09	0.09	0.00
32.00	0.02	1,304	361.70	0.07	0.07	0.00
34.00	0.03	989	361.37	0.06	0.06	0.00
36.00	0.02	731	361.08	0.06	0.06	0.00
38.00	0.02	506	360.79	0.05	0.05	0.00
40.00	0.02	308	360.51	0.04	0.04	0.00
42.00	0.01	134	360.24	0.04	0.04	0.00
44.00	0.00	1	360.00	0.00	0.00	0.00
46.00	0.00	0	360.00	0.00	0.00	0.00
48.00	0.00	0	360.00	0.00	0.00	0.00
50.00	0.00	0	360.00	0.00	0.00	0.00
52.00	0.00	0	360.00	0.00	0.00	0.00
54.00	0.00	0	360.00	0.00	0.00	0.00
56.00	0.00	0	360.00	0.00	0.00	0.00
58.00	0.00	0	360.00	0.00	0.00	0.00
60.00	0.00	0	360.00	0.00	0.00	0.00
62.00	0.00	0	360.00	0.00	0.00	0.00
64.00	0.00	0	360.00	0.00	0.00	0.00
66.00	0.00	0	360.00	0.00	0.00	0.00
68.00	0.00	0	360.00	0.00	0.00	0.00
70.00	0.00	0	360.00	0.00	0.00	0.00
72.00	0.00	0	360.00	0.00	0.00	0.00

Post Construction Inspection Report
Afonso Village II
Grafton, Massachusetts

INSPECTION DATE:						
Person Inspecting		Weather				Other Personnel Present
		Clear				
Item	**N/A***	**sat.****	**NMR*****	**CAM****	**MCA***	**Comments:**
Pavement Swept						
Catch Basins						
CB #1						
CB #2						
CB #3						
Infiltration Basin						
Sediment Forebay						
Infiltration Basin						
NMR* normal maintenance requested						
N/A* not applicable at the time of inspection						
CAM* corrective action - minor						
SAT* satisfactory conditions as compliant						
MCA* Major corrective action						